3.0 AFFECTED ENVIRONMENT

3.1 INTRODUCTION

This chapter describes the existing environment of Cape Canaveral AS, Florida, and Vandenberg AFB, California, and their regions of influence (ROIs). This information serves as a baseline from which to identify and evaluate environmental changes resulting from the implementation of the EELV program. The baseline conditions assumed for the purposes of analysis are the existing conditions at Cape Canaveral AS and Vandenberg AFB. These conditions include activities conducted for the Atlas IIA, Delta II, and Titan IVB launch vehicle programs, which currently support space launches that meet the requirement of the government portion of the NMM.

Although this EIS focuses on the biophysical environment, the following nonbiophysical elements (influencing factors) are addressed: local community, land use and aesthetics, transportation networks, and public utility systems in the regions and local communities. In addition, this chapter describes the storage, usage, disposal, and management of hazardous materials/wastes as well as pollution prevention and Installation Restoration Program (IRP) status. The chapter contains a description of health and safety practices at each installation, and the pertinent natural resources of geology and soils, water resources, air quality, noise, orbital debris, biological resources, and cultural resources. Information on low-income and minority populations in the area used for the environmental justice analysis, concludes the chapter.

The ROI to be evaluated for the two installations is defined for each resource area potentially affected by the Proposed Action and No-Action Alternative. The ROI determines the geographical area to be addressed as the affected environment. Although the installation boundary may constitute the ROI limit for many resources, potential impacts associated with certain issues (e.g., air quality, utility systems, and water resources) transcend these limits. Within each resource discussion, separate ROIs for Concepts A and B are provided, where applicable. The Concept A/B ROI is considered to encompass the ROIs for both Concepts A and B and is therefore not provided separately.

3.2 COMMUNITY SETTING

3.2.1 Cape Canaveral AS

Cape Canaveral AS is situated on the Canaveral Peninsula along the east-central Atlantic Coast in Brevard County, Florida. The Canaveral Peninsula is a barrier island bordered on the east by the Atlantic Ocean, on the west by the Banana River, on the north by the Kennedy Space Center (KSC), and on the south by Port Canaveral. Patrick AFB is also situated south of Cape Canaveral AS. Incorporated cities within Brevard County include Cape Canaveral, Titusville, Cocoa, Melbourne (including Melbourne Beach and Melbourne Village), West Melbourne, Palm Bay, Cocoa Beach, Indialantic, Indian Harbor Beach, Malabar, Satellite Beach, and Rockledge.

3.2.1.1 Employment. In 1997, there were 231,553 total jobs within Brevard County, Florida (Table 3.2-1). The number of jobs in the county grew at an average annual rate of 4.1 percent between 1975 and 1990. During the same period, job growth at the national level was 1.9 percent annually. Between 1994 and 1997, the rate of annual county job growth averaged 2.9 percent.

Table 3.2-1. Summary of Economic Indicators, Brevard County, Florida, Estimates for 1975, 1990, 1994, 1997 and Forecasts for 1998, 2000, 2007, 2015

	1975	1990	1994	1997	1998	2000	2007	2015
Total Jobs[a]	97,084	205,128	212,706	231,553	237,835	250,400	285,540	315,600
Average Annual Change[b]	224	7,433	1,895	6,282	6,282	6,283	5,020	3,360
Average Annual Change (percent)	0.2	4.1	0.9	2.9	2.6	2.6	1.8	1.1

Notes: (a) Total jobs are average annual full- and part-time jobs within Brevard County.
(b) Average Annual Change in each column is calculated over the period of years from the preceding column; for the 1975 column, the change is calculated for the 1975-1990 period.

Sources: U.S. Bureau of Economic Analysis, 1996a, 1996b.

The services and retail trade sectors supported the greatest number of jobs in Brevard County in 1994 with 34.1 percent and 19.2 percent of total jobs, respectively. There were 5,922 jobs, or 2.8 percent of total jobs, in the transportation-communication-public utilities sector in 1994. Manufacturing, with 13.7 percent of total jobs in 1994, and construction, with 6.1 percent, provided the bulk of jobs within the goods-producing sectors (agriculture, mining, manufacturing, and construction). In 1994, state and local government supported about 8.7 percent of all county jobs, and the federal government provided about 5.2 percent of total jobs within Brevard County.

An employment forecast prepared by the U.S. Bureau of Economic Analysis (1996) projected that the number of jobs in Brevard County would increase at an average annual rate of 2.6 percent between 1994 and 2000. By 2000, the forecast projected that there would be more than 250,000 jobs in the county.

The unemployment rate averaged 7.4 percent in 1994, 6.5 percent in 1995, and 5.4 percent in 1996. By comparison, the state unemployment rate was 6.6, 5.5, and 5.1 percent, respectively, for the same 3 years (U.S. Bureau of Labor Statistics, 1997).

3.2.1.2 Population. The total population of Brevard County increased from 398,978 in 1990 to 460,824 in 1997 (Table 3.2-2). A 1997 forecast by the University of Florida Bureau of Economic and Business Research (BEBR) anticipates county population growth of 2.3 percent annually between 1997 and 2000, which would increase total population in Brevard County to 492,803 in 2000. A population forecast prepared by the U.S. Bureau of the Census projects the number of persons in Brevard County to increase at an average annual rate of 2.2 percent between 1994 and 2000 (U.S. Bureau of Economic Analysis, 1996a).

Table 3.2-2. Population, Brevard County, Florida, Estimates for 1990, 1996, and 1997 and Forecasts for 2000, 2007, 2015

	1990	1996	1997	2000	2007	2015
Brevard County	398,978	450,164	460,824	492,803	557,856	629,314
Cape Canaveral	8,014	8,375	8,457	8,701	8,963	9,047
Cocoa	17,722	17,874	17,939	18,134	18,206	18,227
Cocoa Beach	12,123	12,794	12,940	13,379	13,941	14,156
Indialantic	2,844	2,938	2,961	3,029	3,079	3,081
Indian Harbour Beach	6,933	7,579	7,713	8,114	8,809	9,342
Malabar	1,977	2,364	2,445	2,687	3,239	3,929
Melbourne	60,034	66,970	68,395	72,668	80,785	88,313
Melbourne Beach	3,078	3,198	3,226	3,309	3,386	3,403
Melbourne Village	591	612	617	632	644	648
Palm Bay	62,543	74,395	76,860	84,254	100,951	121,515
Palm Shores	210	578	641	829	1,098	1,300
Rockledge	16,023	18,434	18,930	20,418	23,530	26,941
Satellite Beach	9,889	10,106	10,166	10,344	10,382	10,463
Titusville	39,394	41,321	41,749	43,033	44,524	45,167
West Melbourne	8,399	9,171	9,331	9,810	10,637	11,261
Unincorporated	149,204	173,455	178,457	193,462	225,682	262,469

Source: University of Florida, 1997.

With an estimated population of 76,860 persons in 1997, Palm Bay is the largest city in Brevard County. Between 1990 and 1997, Palm Bay's population increased by 14,317, an average of 3.3 percent annually. The population of Melbourne, the second largest city in the county, increased by 8,361, an average of 1.9 percent per year, to 68,395 in 1997. The third largest city, Titusville, increased in population by 2,355, an average of 0.9 percent per year, to 41,749 in 1997. The cities of Rockledge, Cocoa, and Cocoa Beach are the next three largest cities in the county, with populations of 18,930, 17,939, and 12,940, respectively, in 1997.

Almost half of the population growth between 1990 and 1997 occurred in the unincorporated portion of Brevard County. In 1997, the population of unincorporated Brevard County was 178,457.

3.2.2 Vandenberg AFB

Vandenberg AFB is in the western part of unincorporated Santa Barbara County, California. The Santa Ynez River and SR 246 divide the base into North and South Vandenberg AFB. North Vandenberg AFB generally includes the developed portions of the base, whereas South Vandenberg AFB includes primarily open space. The city of Lompoc lies to the east, the city of Santa Maria to the northeast, and the city of Guadalupe to the north. Two unincorporated communities, Vandenberg Village and Mission Hills, are north of the city of Lompoc, and the unincorporated community of Orcutt is north of the base.

3.2.2.1 Employment. In 1997, there were 229,107 total jobs within Santa Barbara County (Table 3.2-3). The number of jobs in the county grew at an average annual rate of 2.3 percent between 1975 and 1990. By comparison,

the number of jobs in the state of California grew at an average annual rate of 2.5 percent during the same period. Between 1990 and 1997, the rate of county job growth averaged 2.4 percent annually.

Table 3.2-3. Summary of Economic Indicators, Santa Barbara County, California, Estimates for 1975, 1990, 1994, 1997 and Forecasts for 1998, 2000, 2001, 2007, 2015

	1975	1990	1994	1997	1998	2000	2007	2015
Total Jobs[(a)]	137,224	217,428	213,313	229,107	234,371	244,900	271,380	292,600
Average Annual Change[(b)]	4,232	4,686	(1,029)	5,265	2,118	5,265	3,782	2,300
Average Annual Change (percent)	3.4	2.3	-0.5	2.4	.9	2.2	1.4	0.8

Notes: (a) Total Jobs are average annual full- and part-time jobs within Santa Barbara County.
(b) Average Annual Change in each column is calculated over the period of years from the preceding column; for the 1975 column, the change is calculated for the 1970-75 period.

Sources: U.S. Bureau of Economic Analysis, 1996a, 1996b, 1997.

The services and retail trade sectors supported the greatest number of jobs in Santa Barbara County in 1994 with 32.2 percent and 17.6 percent, respectively. There were 6,027 jobs, or 2.8 percent of total jobs, in the transportation-communication-public utilities sector in 1994. Manufacturing, with 8.8 percent of total jobs in 1994, and agriculture (including agricultural services, forestry, and fishing) with 8.2 percent, provided the bulk of jobs within the goods-producing sectors. In 1994, state and local government agencies supported about 11.6 percent of all county jobs, and the federal government provided about 3.7 percent of total jobs in Santa Barbara County.

An employment forecast prepared by the U.S. Bureau of Economic Analysis projects the number of jobs in Santa Barbara County to increase at an average rate of 2.3 percent annually between 1994 and 2000 to almost 245,000 total jobs by 2000. The Santa Barbara County Association of Governments is anticipating employment growth to average 1.7 percent annually between 1995 and 2000 (Damkowitch, 1997). The University of California at Santa Barbara (UCSB) Economic Forecast Project projects the number of county jobs to increase at an average annual rate of 1.6 percent between 1996 and 2000.

The county unemployment rate averaged 7.2 percent in 1994, 6.7 percent in 1995, and 5.7 percent in 1996. By comparison, the state unemployment rate averaged 8.6 percent, 7.8 percent, and 7.2 percent, respectively, for those 3 years.

3.2.2.2 Population. The total population of Santa Barbara County increased from 369,608 persons in 1990 to 399,988 in 1997 (Table 3.2-4). A forecast by the Santa Barbara Association of Governments anticipates county population growth of 1.3 percent annually between 1996 and 2000, which would increase total population in the county to 416,213 in 2000 (Damkowitch, 1997). A population forecast prepared by the UCSB Economic Forecast Project projects the number of persons in Santa Barbara County to increase at an average annual rate of 0.9 percent between 1996 and 2000.

A forecast prepared by the U.S. Bureau of the Census projects an average annual growth rate of 1.6 percent between 1994 and 2000.

Table 3.2-4. Population, Santa Barbara County, California, Estimates for 1990, 1996, 1997 and Forecasts for 2000, 2007, 2015

	1990	1996	1997	2000	2007	2015
Santa Barbara County	369,608	394,580	399,988	416,213	445,415	439,320
Buellton[(a)]	NA	3,509	3,623	3,966	4,234	4,528
Carpinteria	13,747	14,490	14,790	15,689	17,320	17,804
Guadalupe	5,479	6,262	6,431	6,936	7,811	8,916
Lompoc	37,649	41,002	41,804	44,208	47,083	48,026
Santa Barbara	85,571	89,370	90,338	93,241	98,217	103,650
Santa Maria	61,552	68,888	70,454	75,152	83,688	96,573
Solvang	4,741	5,109	5,191	5,437	5,890	6,369
Unincorporated	160,869	165,950	167,359	171,584	181,172	193,454

Note: (a) Buellton became an incorporated city in 1993.
NA = not applicable

Sources: California Department of Finance, 1997; Santa Barbara County Association of Governments, 1994.

Santa Barbara, with an estimated population of 90,338 persons in 1997, is the largest city in the county. Between 1990 and 1997, Santa Barbara's population increased by 4,767, an average of 0.8 percent annually. Santa Maria, the second largest city in the county, increased in population by 8,902, an average of 2.0 percent per year, to 70,454 in 1997. The third largest city, Lompoc, increased in population by 4,155, an average of 1.6 percent per year, to 41,804 in 1997.

About 20 percent of the population growth between 1990 and 1997 occurred in the unincorporated portion of Santa Barbara County. In 1997, the population of the unincorporated portion of the county was 167,359.

Incorporated in 1993, the city of Buellton, with 3,623 persons in 1997, is anticipated to experience the greatest rate of growth in the county between 1997 and 2000, at 3.1 percent per year. Lompoc and Santa Maria are forecast to experience average annual growth rates of 2.6 percent and 2.2 percent, respectively, during the same period.

3.3 LAND USE AND AESTHETICS

This section describes the existing environment in terms of land use and aesthetics for the areas on and surrounding Cape Canaveral AS and Vandenberg AFB. Topics addressed are regional land use, on-station/base land use, coastal zone management, recreation, and aesthetics.

Land use can be defined as the human use of land resources for various purposes including economic production, natural resources protection, or institutional uses. Land uses are frequently regulated by management plans, policies, ordinances, and regulations that determine the types of uses that

are allowable or protect specially designated or environmentally sensitive uses.

Potential issues typically stem from encroachment of one land use or activity on another, or an incompatibility between adjacent land uses that leads to encroachment. Cape Canaveral AS and Vandenberg AFB coordinate with surrounding local and state jurisdictions to ensure that off-station/base development does not encroach on installation activities, and that installation activities do not encroach on, or create land use incompatibilities with, off-station/base uses.

Visual resources include natural and man-made features that give a particular environment its aesthetic qualities. The analysis considers visual sensitivity, which is the degree of public interest in a visual resource and concern over adverse changes in the quality of the resource.

3.3.1 Cape Canaveral AS

The ROI for land use at Cape Canaveral AS encompasses the station boundaries and potentially affected adjacent lands, including off-station lands within launch safety clear zones or land uses that may be affected by activities on the station.

3.3.1.1 Regional Land Use. Brevard County and the city of Cape Canaveral are the local planning authorities for incorporated and unincorporated areas near Cape Canaveral AS. Land uses designated by Brevard County for Merritt Island (a barrier island located between the Indian River and the Atlantic Ocean) include residential, industrial, public facilities, agricultural, recreation, and conservation (Figure 3.3-1). The City of Cape Canaveral Comprehensive Plan (Briley, Wild and Associates, 1990) designates residential, commercial, industrial, public facilities and recreation, and open space land use areas, with continued commercial and industrial uses planned for Port Canaveral. Port Canaveral is also used by NASA, the Navy, and the Air Force to support launch and shipping activities. Neither the county nor the city of Cape Canaveral has land use authority over Cape Canaveral AS land because it is federally owned. Cape Canaveral AS designates its own land use and zoning regulations. The general plans of the county and City of Cape Canaveral designate compatible land uses around Cape Canaveral AS.

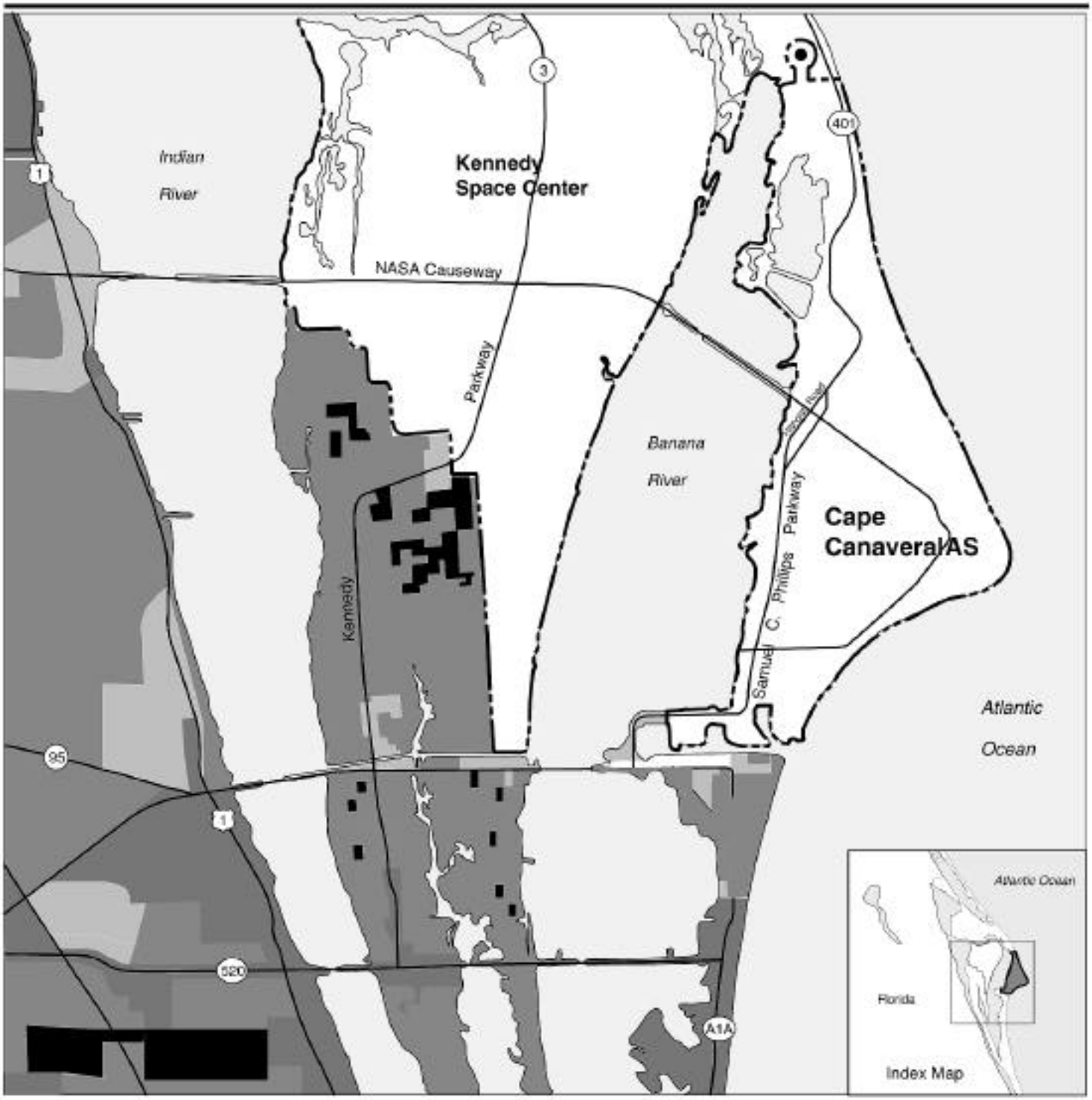
KSC, which is north and west of Cape Canaveral AS, includes predominantly industrial uses associated with NASA launch programs and open space associated with the Merritt Island National Wildlife Refuge. Uses of the river and ocean water areas surrounding Cape Canaveral AS include commercial fishing, marine recreation, and marine transportation.

3.3.1.2 Cape Canaveral AS Land Use. Cape Canaveral AS encompasses an area of 15,800 acres, representing approximately 2 percent of the total land area of Brevard County. Land uses at Cape Canaveral AS include launch operations, launch and range support, airfield, port operations, station support area, and open space (Figure 3.3-2).

The launch operations land use category is present along the Atlantic Ocean shoreline and includes the active (SLCs 17A and B, SLCs 36A and B,

SLC-40, and SLC-41) and inactive (all other SLCs) launch sites and support facilities. The launch and range support area is west of the launch operations land use area and is divided into two sections by the airfield (Skid Strip). The airfield includes a single runway, taxiways, and apron, and is in the central part of the station. The port operations area is in the southern part of the station and includes facilities for commercial and industrial activities. The major industrial area is located in the center of the western portion of the station, near the Banana River, and is shown on Figure 3.3-2 under the station support area category. Although many of the activities are industrial in nature, this land use area includes administrative, recreational, and range support functions. Open space is dispersed throughout the station. The areas around SLC-37 and SLC-41 are within the launch operations land use area. There are no public beaches located on Cape Canaveral AS.

3.3.1.3 Coastal Zone Management. Federal activity in, or affecting, a coastal zone requires preparation of a Coastal Zone Consistency Determination, in accordance with the federal Coastal Zone Management Act (CZMA) of 1972, as amended (P.L. 92-583), and implemented by the National Oceanic and Atmospheric Administration (NOAA). This act was passed to preserve, protect, develop and, where possible, restore or enhance the nation's natural coastal zone resources, which include wetlands,



EXPLANATION

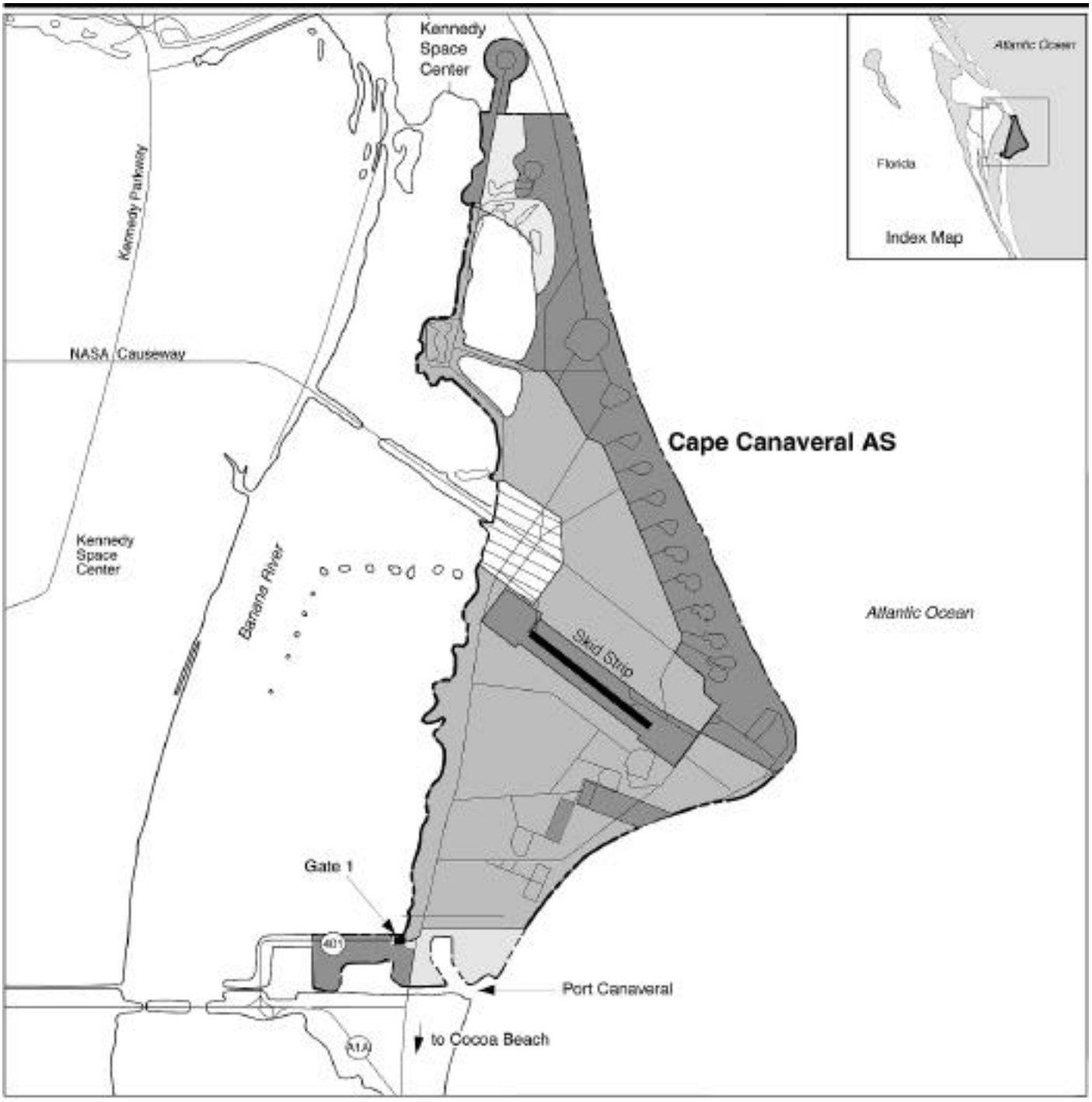
- Station/Government Property Boundary
- Industrial (includes port operations)
- Public Facilities/ Recreation
- Residential
- Mixed Use
- Conservation
- Agriculture

0 1 2 4 Miles

Off-Station Land Use, Cape Canaveral AS, Florida

Figure 3.3-1

EELV/107



EXPLANATION

- Station Boundary
- Airfield
- Station Support Area*
- Launch and Range Support
- Open Space
- Port Operations
- Launch Operations

On-Station Land Use Cape Canaveral AS, Florida

0 3000 6000 12000 Feet

* This land use includes industrial, administrative, launch and range support, and outdoor recreation areas.

Source: 45 Space Wing, 1995

Figure 3.3-2

EELV/C70

floodplains, estuaries, beaches, dunes, barrier islands, coral reefs, and fish and wildlife and their habitat. The act also requires the management of coastal development to minimize the loss of life and property caused by improper development in a coastal zone. Responsibility for administering the Coastal Zone Management Program (CZMP) has been delegated to states that have developed state-specific guidelines and requirements. A federal agency must ensure that activities within the coastal zone are consistent with that state's coastal zone management program.

In Brevard County, the Florida Coastal Management Program, formed by the Florida Coastal Management Act (FCMA), applies to activities occurring in or affecting the coastal zone. The entire state of Florida is defined as being within the coastal zone. For planning purposes, a "no development" zone has been established. In Brevard County, the no development zone extends from the mean high water level inland 75 feet. Cape Canaveral AS has additional siting and facility design standards for construction near the coast, which require that facilities be set back at least 150 feet from the coast. The Florida Department of Community Affairs (FDCA) is the state's lead coastal management agency. The Air Force is responsible for making the final coastal zone consistency determinations for its activities within the state, and the FDCA will review the coastal zone consistency determination.

3.3.1.4 Recreation. Recreational activities near Cape Canaveral AS center mainly around the coastal beaches and large expanses of inland waters in the Indian and Banana rivers, the St. John's River, and large freshwater lakes. Boating, surfing, water skiing, and fishing are common activities. Brevard County provides several parks within the area surrounding the station. Jetty Park is situated immediately south of Port Canaveral on the beach and is the only park in the area that allows overnight camping. Public parks in the region are not affected by launch activities from Cape Canaveral AS. The beaches along Cape Canaveral AS are used for launch operations and are therefore restricted from public use. Recreational fishing is allowed at SLCs 34 and 16, and Camera Road A and B for KSC and Cape Canaveral AS personnel and their guests.

3.3.1.5 Aesthetics. The ROI for aesthetics at Cape Canaveral AS includes the general visual environment surrounding the station and areas of the station visible from off-station areas.

The visual environment in the vicinity of Cape Canaveral AS is characterized by the barrier island on which it is located. The Indian and Banana rivers separate the barrier island from the mainland. Topography of the island is generally flat, with elevations ranging from sea level to approximately 20 feet above sea level. The landscape is dominated by Florida coastal strand, coastal scrub, and coastal dune vegetation. The most visually significant aspect of the natural environment is the gentle coastline and flat island terrain. The area has a low visual sensitivity because the flatness of the area limits any prominent vistas.

Cape Canaveral AS is fairly undeveloped. The most significant man-made features are the launch complexes and various support facilities. These developed areas are surrounded by disturbed grasses, oak hammocks, and

scrub vegetation. Most of Cape Canaveral AS outside of the developed areas is covered with native vegetation.

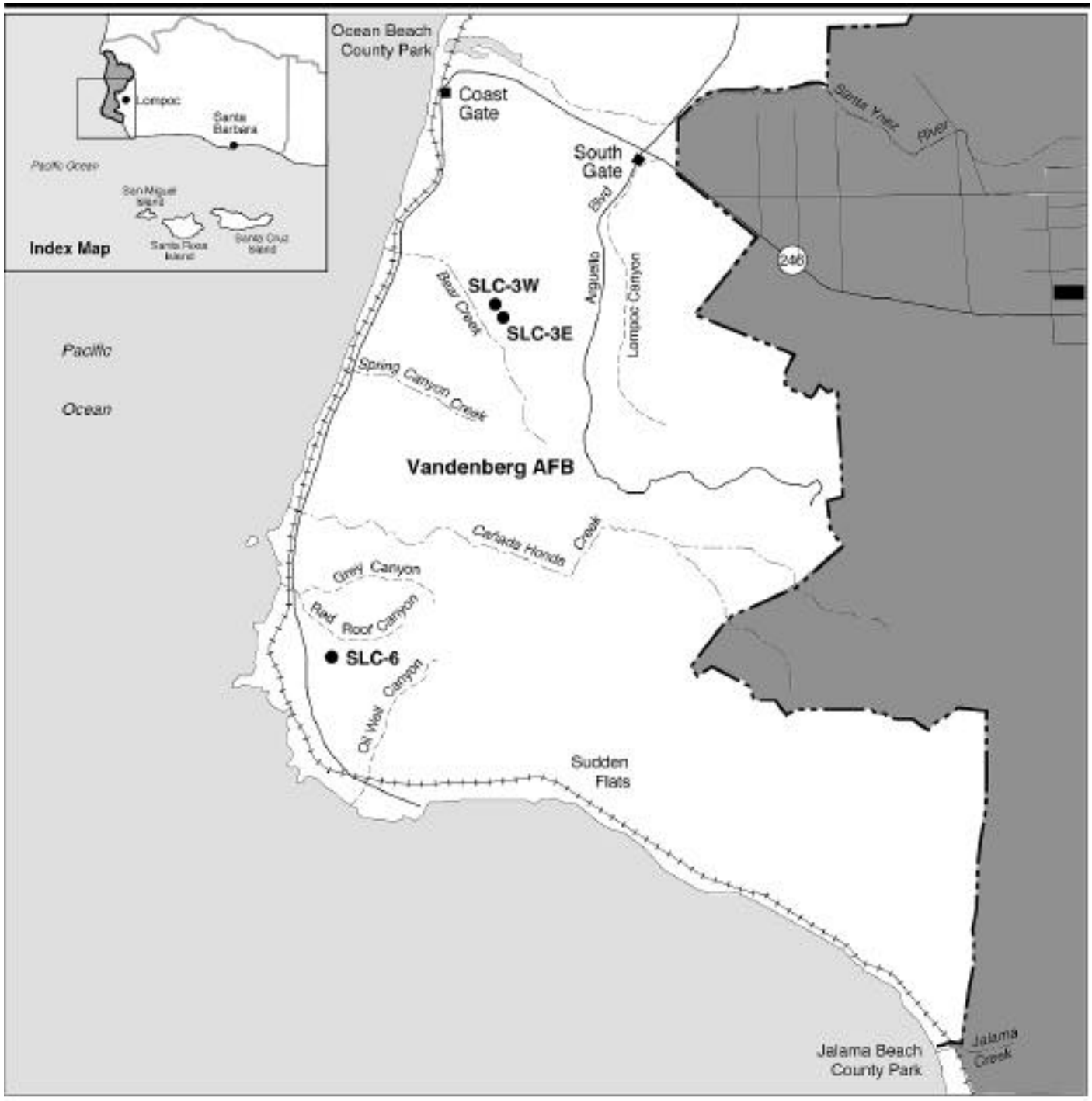
Since public access to the station is prohibited, viewpoints are primarily limited to marine traffic on the east and west and distant off-site beach areas and small communities to the south. The station is bordered by approximately 15 miles of the Atlantic coastline on the east and approximately 12 miles of shoreline on the west. However, marine traffic is limited and public observation of the coastline is infrequent. Marine traffic consists mainly of transportation and fishing vessels, pleasure boats, and cruise ships. From the south, launch complexes can be viewed from various beach areas and small communities including Port Canaveral and the cities of Cape Canaveral and Cocoa Beach. Additionally, from KSC (north and west of the station), views of the launch complexes are available to a limited population.

3.3.2 Vandenberg AFB

The ROI for land use at Vandenberg AFB encompasses the base boundaries and potentially affected adjacent lands including off-base lands within launch safety clear zones or land uses that may be affected by increased on-base activities.

3.3.2.1 Regional Land Use. Santa Barbara County and the cities of Lompoc and Santa Maria are the local planning authorities for both incorporated and unincorporated areas adjoining the base. Of these planning authorities, only the county adjoins areas of South Vandenberg AFB near the proposed launch complexes. Neither the county nor the cities of Lompoc and Santa Maria have land use authority over Vandenberg AFB land because it is federally owned. Vandenberg AFB designates its own land use and zoning regulations. The general plans of the county and cities of Lompoc and Santa Maria designate compatible land uses around Vandenberg AFB. Figure 3.3-3 shows land uses adjacent to South Vandenberg AFB.

Santa Barbara County land use plans designate much of the area adjoining the base as agricultural. This designation is applied to the productive agricultural soils of the Lompoc and Santa Maria valleys. Other nonurban land east of the base is designated for rural residential use. Two large ranches, the Bixby Ranch and the Hollister Ranch, are located more than 10 miles southeast of SLC-6. Although some residential development has occurred, these ranches have been traditionally used for cattle grazing. Both



EXPLANATION

- Industrial
- Residential
- Agriculture
- Commercial
- Industrial
- Vandenberg AFB Boundary

Off-Base Land Use, South Vandenberg AFB, California

0 .5 1 2 Miles

Figure 3.3-3

EEL/106

of these properties are within the coastal zone of Santa Barbara County and are therefore governed by the county Coastal Plan, which regulates land use authority within the coastal zone, rather than the General Plan and zoning regulations. The Coastal Plan is intended to maintain non-prime agricultural operations (e.g., grazing) in the coastal areas of northern Santa Barbara County through large-lot zoning. Both ranch properties are currently used for agricultural purposes.

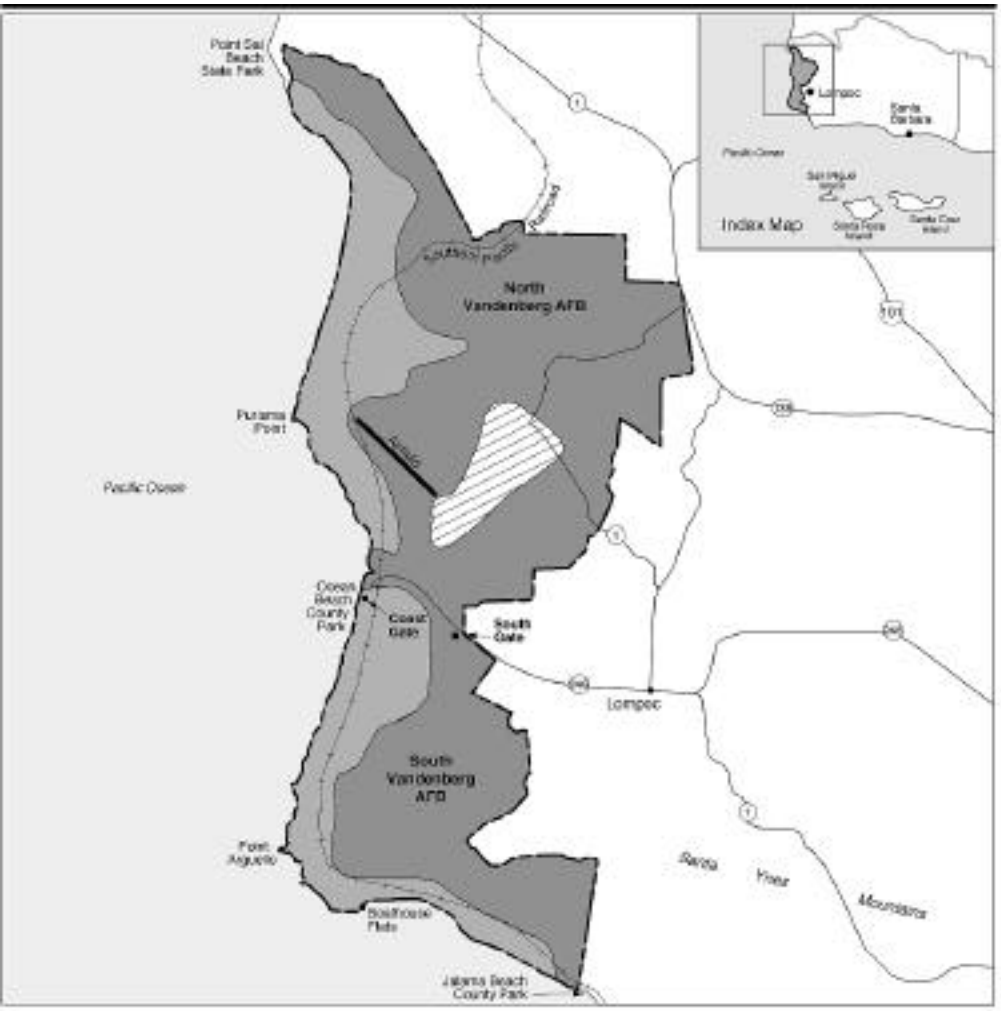
Urban land use dominates within the cities of Lompoc and Santa Maria, and the unincorporated communities of Vandenberg Village and Mission Hills. Outside of these areas, other land uses adjacent to the base are primarily agriculture and grazing, with some scattered oil production activities and other undeveloped uses (primarily recreation). To the west, offshore uses of the Pacific Ocean and beaches include primarily oil production, commercial fishing, and recreation. Three public beaches are near the base: Point Sal Beach State Park to the north, Ocean Beach County Park at the terminus of SR 246 near the north/south division of Vandenberg AFB, and Jalama Beach County Park, which is south of the base.

3.3.2.2 Vandenberg AFB Land Use. Vandenberg AFB encompasses approximately 98,400 acres, representing approximately 6 percent of the total land area of Santa Barbara County. According to the Base Comprehensive Plan (U.S. Air Force, 1989d), the base is generally divided into three functional areas: the base support area, the technical support area, and launch areas (Figure 3.3-4). The base support area includes the urban portion of the base, including family housing, industrial, and administrative areas, and is centrally located, north of SR 246. The technical support area encompasses the largest area on base and includes the airfield and munitions, fuel, and hazardous materials storage areas and associated safety zones. The launch areas are generally within a coastal corridor north and south of SR 246 and include launch pads and facilities and surrounding open space for safety zones.

The greatest use of land on Vandenberg AFB (60 percent) is for open space and recreation, followed by agriculture (37 percent), primarily grazing. These two areas are generally found within the launch and technical support areas.

Development has occurred mainly on North Vandenberg AFB, primarily within the base support area. The remaining north base development includes an airfield and test/launch facilities, which are within the launch and technical support areas.

The majority of South Vandenberg AFB is undeveloped; the developed portion includes launch complexes, test/launch facilities, technical support areas, several mountaintop tracking stations, and a 150-acre administrative/ industrial area. Some of the undeveloped areas on South Vandenberg AFB are leased for grazing.



EXPLANATION

- Base Boundary
- Base Support Area*
- Launch Area
- Technical Support Area

0 .75 1.5 3 Miles

* This land use area includes residential, administrative, industrial, recreation, airfield, and community services uses.

Source: U.S. Air Force, 1988

On-Base Land Use
Vandenberg AFB,
California

Figure 3.3-4

EELV007I

3.3.2.3 Coastal Zone Management. Federal activity in, or affecting, a coastal zone requires preparation of a Coastal Zone Consistency Determination, in accordance with the federal CZMA Management Act of 1972, as amended P.L. 92-583), and implemented by the NOAA (see Section 3.3.1.3).

The California Coastal Zone Management Program was formed through the California Coastal Zone Conservation Act of 1972. The Air Force is responsible for making final coastal zone consistency determinations for its activities within the state, and the California Coastal Commission reviews federally authorized projects for consistency with the California Coastal Zone Management Program.

Under the Coastal Plan for Santa Barbara County, the Santa Barbara County coastline is divided into seven subareas. The subarea along the western boundary of Vandenberg AFB is the North Coast Planning Area. On Vandenberg AFB, the coastal zone extends inland from approximately 3/4 mile at the northern boundary to 4-1/2 miles at the southern end of the base. It varies in width between the northern and southern boundaries, with the widest portion occurring at San Antonio Creek and south of Cañada Honda Creek to the southern boundary (Santa Barbara County, 1982).

3.3.2.4 Recreation. The recreational opportunities in the vicinity of Vandenberg AFB provide limited public access to the base's shoreline up to the mean high tide line. Ocean Beach and Jalama Beach county parks may be closed during launch activities on Vandenberg AFB.

Jalama Beach County Park is situated at the southern end of the base and is reached via Jalama Road from SR 1 (see Figure 3.3-4). Amenities are provided for day-use picnicking, and there are approximately 100 sites available for overnight camping. Approximately 122,400 people visited the park from June 1995 to June 1996, 60 percent of whom camped overnight. The park is closed to the public during low-azimuth Titan launches, in accordance with EWR 127-1, Range Safety Requirements. The Santa Barbara County Parks Department, County Sheriff, and California Highway Patrol are notified of scheduled launch events. Park rangers post a notice indicating the time and date of park closure. The County Sheriff usually initiates procedures for barricading about 6 hours prior to launch, and the park ranger clears the area. Following the launch or launch cancellation, the Air Force informs the park ranger and sheriff, and the park is reopened. Between 1990 and 1995, the park averaged one closure per year. The park is closed for approximately 8 hours per launch event.

Ocean Beach County Park is located between North and South Vandenberg AFB and is reached via SR 246 (see Figure 3.3-4). The park provides amenities for day-use picnicking and sightseeing and was visited by approximately 63,000 people in 1993. Ocean Beach County Park is closed for Atlas, Delta, and Titan launches. Closure procedures for this park are similar to those used for Jalama Beach County Park. Between 1990 and 1995, the park was closed an average of three times per year for an average of 8 hours per launch event.

The Boathouse Flats area on South Vandenberg AFB, the former location of the U.S. Coast Guard Rescue Station, provides Air Force personnel and their guests picnicking, diving, swimming, and fishing recreation opportunities. Approximately 1,800 persons use this area annually. Boathouse Flats lies on the coast south of SLC-6. This area would experience the same closures as Jalama Beach County Park during low-azimuth Titan launches.

3.3.2.5 Aesthetics. The ROI for aesthetics at Vandenberg AFB includes the general visual environment surrounding the base and areas of the base visible from off-base areas.

The visual environment in the vicinity of Vandenberg AFB is varied and characterized by rolling hills covered with chaparral and oak trees, valleys utilized for grazing or more intensive agriculture, and urbanized areas of the Lompoc Valley. Topography is largely dominated by the east-west-trending Santa Ynez Mountains that narrow toward the coast and terminate at Point Arguello. Views of the coastline are generally not available from inland locations due to access limitations and intervening topography.

South Vandenberg AFB is characterized by the somewhat rugged terrain of the western Santa Ynez Mountains, which rise to more than 2,000 feet at Tranquillon Peak. From this elevation, the mountains drop toward the coast, terminating at a narrow marine terrace at about 50 to 100 feet above the ocean. Slopes and terraces are covered with grasses and chaparral or coastal sage vegetation. With the exception of scattered launch facilities, South Vandenberg AFB is generally undeveloped. The most visually significant aspects of the natural environment are the rugged coastline and adjacent mountain slopes, and the most significant man-made features are the launch complexes.

Vandenberg AFB has a low visual sensitivity because views of South Vandenberg AFB from the east, and from the approximately 40 miles of coastline, are generally restricted by distance from public/private land, limited roadways, and the topography of the Santa Ynez Mountains that extend to Point Arguello at Cypress Ridge. Since public access to South Vandenberg AFB is generally not permitted, viewpoints are primarily limited to marine traffic, passengers on the Southern Pacific Railroad that traverses through the area parallel to the coastline, and views from Ocean Beach and Jalama Beach county parks.

The marine traffic consists primarily of fishing vessels and occasional pleasure boats. Visibility from the ocean is limited. Passenger railroad traffic provides the closest views of the area; about four passenger and eight freight trains pass through Vandenberg AFB daily. From the west, views for marine and railroad traffic include both SLC-3 and SLC-6. Views of the South Vandenberg AFB coastline north of Point Arguello are available from Ocean Beach County Park. Views from this location include SLC-3 and SLC-4; SLC-6 is not visible from the park.

From the south, views of the South Vandenberg AFB coastline are available from Jalama Beach County Park, which offers views north to Point Arguello. This area offers expansive views reflecting the predominantly undeveloped nature of the coastline. Existing launch facilities, such as SLC-3 and SLC-6,

cannot be seen from this location due to the intervening topography of the Santa Ynez Mountains.

3.4 TRANSPORTATION

This section addresses roadways and railways. The ROI for the roadways analysis includes the key road networks that provide access to Cape Canaveral AS and Vandenberg AFB. The analysis will focus on the immediate areas and local roadways surrounding the two installations. The rail networks in the vicinities of the two installations are described.

Roadways. The evaluation of the existing roadway conditions focuses on capacity, which reflects the ability of the network to serve the traffic demand and volume, usually expressed in number of vehicles per hour. The capacity of a roadway depends on the street width, number of lanes, intersection control, and other physical factors. Depending on the project and data available, traffic volumes are typically reported as the number of vehicular movements averaged over a daily period (ADT) or an annual period (AADT). Peak-hour volume (PHV) is defined as the highest volume of traffic in a 24-hour period that is recorded on a segment of roadway or intersection during a 1-hour period. The ADT and PHV values are useful indicators in determining the extent to which the roadway segment is used, and in assessing the potential for congestion or other traffic problems.

The performance of a roadway segment is generally expressed in terms of level of service (LOS). The LOS scale ranges from A to F, with each level defined by a range of volume-to-capacity (V/C) ratios. LOS A, B, and C are considered good operating conditions under which minor to tolerable delays are experienced by motorists. LOS D represents below-average conditions. LOS E reflects a roadway at maximum capacity, and LOS F represents traffic congestion. Table 3.4-1 presents the LOS designations and their associated V/C ratios used in this analysis.

Existing roads and highways within the ROI are described at two levels: (1) regional roads, representing key regional access, and (2) local roads, representing roads connecting the project site to regional roads within

Table 3.4-1. Road Transportation Levels of Service

LOS	Description	Criteria (V/C) Multi-Lane Arterial	Criteria (V/C) 2-Lane Highway
A	Free flow with users unaffected by presence of other roadway users	0-0.3	0-0.15
B	Stable flow, but presence of the users in traffic stream becomes noticeable	0.31-0.5	0.16-0.27
C	Stable flow, but operation of single users becomes affected by interactions with others in traffic stream	0.51-0.7	0.28-0.43
D	High density, but stable flow; speed and freedom of movement are severely restricted; poor level of comfort and convenience	0.71-0.84	0.44-0.64
E	Unstable flow; operating conditions at capacity with reduced speeds, maneuvering difficulty, and extremely poor levels of comfort and convenience	0.85-1.00	0.65-1.00
F	Forced breakdown flow with traffic demand exceeding capacity; unstable stop-and-go traffic	>1.00	>1.00

LOS = level of service
V/C = volume to capacity

Source: Compiled from Transportation Research Board, 1994.

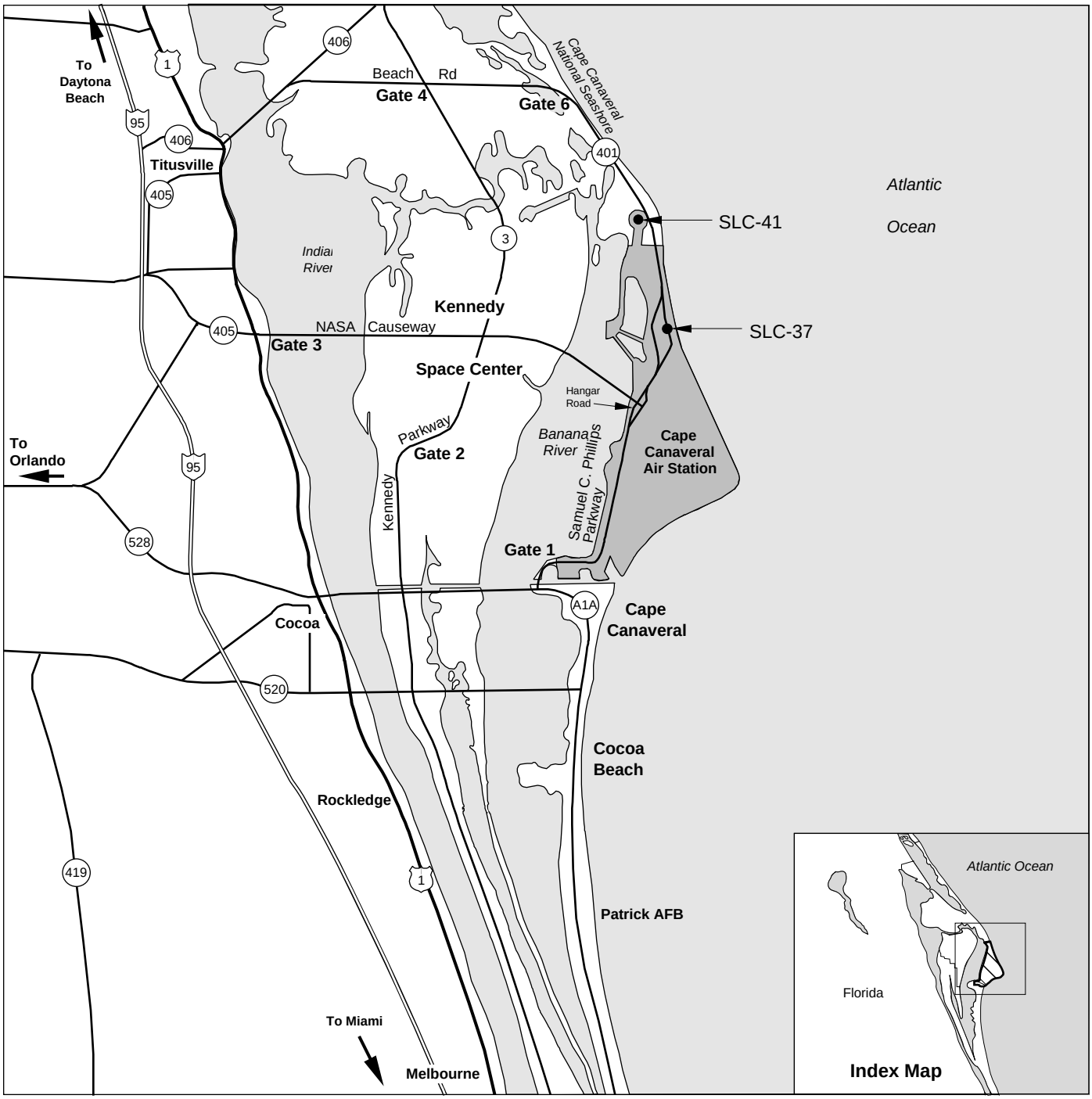
the ROI. The local road network selected for analysis was determined based on the residential distribution of current employees. Traffic data and physical roadway characteristics were obtained primarily from data provided by the state and local highway departments.

The capacity of each roadway segment surrounding Cape Canaveral AS and Vandenberg AFB was determined using existing roadway geometric characteristics.

3.4.1 Cape Canaveral AS

3.4.1.1 Regional. The Cape Canaveral AS area can be accessed from Daytona Beach and other locations via U.S. Highway (U.S.) 1 or Interstate 95 (Figure 3.4-1). Orlando lies approximately 50 miles to the west on SR 528, and Miami is approximately 187 miles to the south on U.S. 1 or Interstate 95.

Local. The majority of the employees and other related support services providers for Cape Canaveral AS reside within the unincorporated areas of Brevard County and in the cities of Cape Canaveral, Cocoa, Cocoa Beach, and Rockledge, which are all within 14 miles of the station. The key local roads providing access to Cape Canaveral AS from KSC and the local



EXPLANATION

- 101 — U.S. Highway
- 95 — Interstate Highways
- 154 — State Route
- Cape Canaveral AS

Regional and Local Road Systems, Cape Canaveral AS, Florida

0 1.25 2.5 5 Miles

Figure 3.4-1

EELV/090

communities include SR A1A, SR 520, SR 528, SR 401, SR 3, and SR 405. The NASA Causeway and Beach Road connect KSC and Cape Canaveral AS (see Figure 3.4-1).

Southern access into Cape Canaveral AS through Gate 1 is provided by SR 401, SR A1A, SR 520, and SR 528. SR 401 is a 5-lane road that narrows to a 4-lane divided road as it approaches Gate 1 where it becomes Samuel C. Phillips Parkway. SR A1A is a north-south, 4-lane divided highway to the south of Cape Canaveral AS that is used as a transportation corridor connecting SR 401 with the cities of Cape Canaveral and Cocoa Beach, and Patrick AFB. SR 520 is a 4-lane, east-west urban roadway that connects the cities of Cocoa and Rockledge to Merritt Island. By 2010, the road is expected to be resurfaced to a 6-lane roadway. As it continues east, SR 520 connects with SR A1A. SR 528 is a 4-lane, limited-access toll road that approaches the southern portion of Cape Canaveral AS from the west, connecting the mainland to Merritt Island and the barrier islands. The road is used extensively by KSC personnel. SR 528 and SR A1A merge into SR 401 just south of Cape Canaveral AS.

Western access onto Cape Canaveral AS is provided by SR 3 and SR 405. SR 3 is a north-south highway that bisects KSC. It becomes Kennedy Parkway on KSC and provides access to Gate 2. SR 405 is a 4-lane road providing access to Cape Canaveral AS from the west. It turns into the NASA Causeway after entering KSC at Gate 3.

From the north, Cape Canaveral AS can be accessed through Gate 4 and Gate 6 at KSC. SR 3 provides access to Gate 4 from the north, and Beach Road provides access to Gate 4 and Gate 6 from the west. Beach Road becomes SR 401 as it approaches Cape Canaveral AS and subsequently turns into Samuel C. Phillips Parkway. PHVs and existing LOS for key roads on Cape Canaveral AS are presented in Table 3.4-2.

Table 3.4-2. Peak-Hour Traffic Volumes and LOS on Key Roads - Cape Canaveral AS

Roadway	Segment/No. of Lanes	Capacity VPH	1996 PHV	LOS
SR A1A	South from Samuel C. Phillips Parkway; 4-lane	8,000	3,950	C
SR A1A	East from Samuel C. Phillips Parkway; 4-lane	8,000	3,750	B
NASA Causeway	Between U.S. 1 and Samuel C. Phillips Parkway; 4-lane	8,000	1,750	A
Samuel C. Phillips Pkwy/Hangar Road	Between Gate 1 and SR 401 (Gate 6); 4-lane	8,000	1,900	A

LOS = level of service
NASA = National Aeronautics and Space Administration
PHV = peak-hour volume
SR = State Route
U.S. = U.S. Highway
VPH = vehicles per hour

On-Site. The major on-site roadway on Cape Canaveral AS is Samuel C. Phillips Parkway, a 4-lane divided highway that accommodates most of the north-south traffic. At its intersection with Skid Strip Road, Samuel C. Phillips Parkway becomes a one-way northbound arterial, with Hangar Road serving as the southbound arterial. Samuel C. Phillips Parkway provides access to

the launch site locations (SLC-41 and SLC-37). To the north and south of Cape Canaveral AS, Samuel C. Phillips Parkway becomes SR 401.

3.4.1.2 Railways. The ROI for railways includes the Florida East Coast Railway, which provides rail service to Brevard County through the cities of Titusville, Cocoa, and Melbourne. An additional railway in the ITL area on Cape Canaveral AS is accessible by the Florida East Coast Railway through KSC and Titusville.

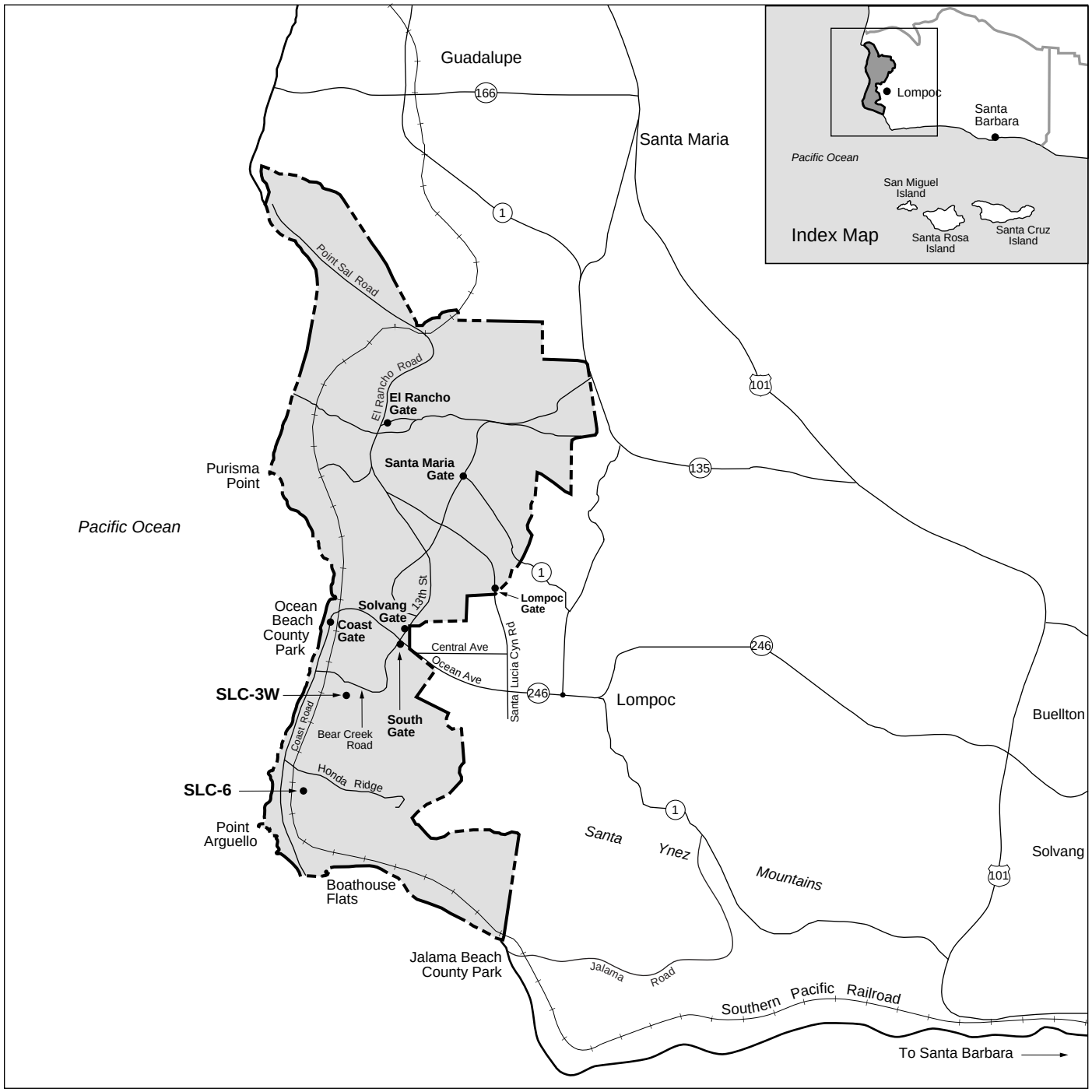
3.4.2 Vandenberg AFB

3.4.2.1 Regional. Vandenberg AFB is accessible by U.S. 101, which connects the base with San Francisco on the north and Santa Barbara on the south. SR 1, SR 135, and SR 246 provide access to the base from U.S. 101.

Local. The majority of the workers and other related support services providers for Vandenberg AFB reside within the unincorporated areas of Santa Barbara County and in the cities of Lompoc, Santa Maria, Guadalupe, Buellton, Solvang, and Santa Barbara. The key local roads providing access to Vandenberg AFB include SR 1, SR 135, Santa Lucia Canyon Road, SR 246, U.S. 101, and Central Avenue (Figure 3.4-2).

Vandenberg AFB is accessible through the northeast at the Santa Maria Gate by SR 1, a 4-lane rural expressway extending primarily along the coastal region of California. SR 1 connects with SR 135 south of the city of Santa Maria.

SR 246, Central Avenue, and Santa Lucia Canyon Road provide eastern access to Vandenberg AFB. SR 246 leads to two base gates, the South Vandenberg AFB Gate and Solvang Gate. SR 246 is a 2-lane rural highway connecting Lompoc to U.S. 101, a divided, 4-lane, major arterial. SR 246 becomes Ocean Avenue within the city of Lompoc and is one of the main transportation routes connecting Lompoc with Vandenberg AFB. Ocean Avenue is a major east-west, 4-lane divided road running through southern Lompoc. Central Avenue connects SR 1 with Ocean Avenue, and subsequently, SR 246. Central Avenue is a 2-lane undivided street running east-west through the northern part of Lompoc. The other western gate is Lompoc Gate, north of the city of Lompoc, and accessible through Santa Lucia Canyon Road, a 2-lane undivided highway. Santa Lucia Canyon Road runs north-south, connecting Ocean Avenue with Lompoc Gate. PHVs and existing LOS for key roads on Vandenberg AFB are presented in Table 3.4-3.



EXPLANATION

- Base Boundary
- 101 U.S. Highway
- 135 State Route

Regional and Local Road Systems, Vandenberg AFB, California

0 1 2 4 Miles

Figure 3.4-2

EELV/089

Table 3.4-3. Peak-Hour Volumes and LOS on Key Roads - Vandenberg AFB

Roadway	Segment/No. of Lanes	Capacity VPH	1996 PHV	LOS
Coast Road	Between SLC-6 and Bear Creek Road; 2-lane	2,800	350	A
Bear Creek Road	Between Coast Road and Ocean Avenue; 2-lane	2,800	350	A
13th Street	Between Ocean Avenue and Santa Maria Gate; 2-lane	2,800	1,550	D
Ocean Avenue	Between Bear Creek Road and SR 1; 4-lane	8,000	250	A
SR 1	Between Santa Maria Gate and SR 135; 4-lane	8,000	1,550	B

LOS = level of service
PHV = peak-hour volume
SR = State Route
VPH = vehicles per hour

Source: Santa Barbara County Planning Department Traffic Count, 1996

On-Site. The major roads on Vandenberg AFB that provide access to the project sites are Coast Road, Bear Creek Road, 13th Street, and Ocean Avenue. Coast Road is a 2-lane undivided roadway providing access to SLC-6. Coast Road connects to Bear Creek Road, north of SLC-6. Bear Creek Road is a 2-lane arterial that provides access to the launch site location SLC-3W. Bear Creek Road is accessible through 13th Street from the north or Ocean Avenue from the east. The Solvang Gate, Santa Maria Gate, and El Rancho Gate are connected to 13th Street, a 2-lane arterial that runs north-south on the base. Ocean Avenue is an east-west road that bisects Vandenberg AFB and connects with Bear Creek and Coast roads. The Solvang and South Vandenberg AFB gates are located just north and south, respectively, of Ocean Avenue.

3.4.2.2 Railways. The ROI for railways includes the Southern Pacific, Santa Maria Valley, and the Ventura County Railroad companies, which provide services to the cities of Santa Maria, Lompoc, Santa Barbara, San Luis Obispo, and Ventura. Three branch lines connect Vandenberg AFB to the Southern Pacific Railroad main line. Approximately four passenger and eight freight trains pass through Vandenberg AFB daily. The railroad tracks pass between the Pacific Ocean and the launch facilities and must be overflown during launches; however, trains are never overflown during launches due to the potential risk to people and property. An electronic surveillance system, posted railroad schedules, and close coordination, including radio communication, between train engineers and Vandenberg AFB launch personnel, are used to minimize the possibility of an overflight.

3.5 UTILITIES

The utility systems addressed in this EIS include the facilities and infrastructure used for potable water supply, wastewater collection and treatment, solid waste disposal, and electricity.

The ROI for utilities consists of all or portions of the service areas of each utility provider that serves the project site, other installation facilities, and

incorporated and unincorporated areas of the applicable county. The major attributes of utility systems in the ROI are processing, distribution, and storage capacities, and related factors, such as average daily consumption and daily peak demand. These factors are used in determining whether the existing utility systems are capable and adequate to provide services to the project sites in the future.

ROI utility use was determined from records of purveyors, historic consumption patterns, and system-wide average annual growth rates.

3.5.1 Cape Canaveral AS

Potable water, wastewater, solid waste, and electrical systems for Cape Canaveral AS and the surrounding area are discussed in this section.

3.5.1.1 Water. The ROI for water supply and distribution consists of Patrick AFB, Cape Canaveral AS, KSC, the cities of Cocoa, Cocoa Beach, Rockledge, Cape Canaveral, unincorporated areas of Merritt Island, and unincorporated areas north, west, and south of the city of Cocoa. The water delivered to the ROI comes from the Florida aquifer and is delivered by the city of Cocoa's water distribution system, with a capacity of 37 million gallons per day (MGD). In 1995, the water consumption in the ROI averaged 25 MGD. Cape Canaveral AS used an average of 0.75 MGD including deluge water in 1995 and has a system capacity of 3 MGD.

Water is supplied to the launch complexes through the domestic water distribution system. Ten ground-level tanks with a total capacity of 5,900,000 gallons are used to store deluge water, which is supplied to the launch pads. Because these tanks are used infrequently, the stored water can become stagnant and chlorine levels can dissipate below acceptable human consumption levels. This condition also occurs in the large-volume pipes for the deluge system because average daily water use is small compared to the quantity in large-volume pipes. To prevent this stagnant water from contaminating drinking water, Cape Canaveral AS plans to install a separate piping system. In 1995, there were 16 launches from Cape Canaveral AS, resulting in use of approximately 3,200,000 gallons of deluge water.

3.5.1.2 Wastewater. Cape Canaveral AS treats both domestic and industrial wastewater on site. The wastewater treatment plant has a permitted capacity of 0.8 MGD and a peak daily flow of approximately 0.6 MGD. Cape Canaveral AS has an industrial wastewater permit to discharge deluge water to grade or to pump to the WWTP for treatment. Maximum total flow of wastewater from domestic use allows a residual wastewater capability of approximately 200,000 gpd for treatment of contaminated deluge water, if required.

3.5.1.3 Solid Waste. The ROI for solid waste management consists of the cities located within central Brevard County. General solid refuse at Cape Canaveral AS is collected by a private contractor and disposed of off-site at the Brevard County Landfill, a 192-acre Class I landfill located near the city of Cocoa. In 1995, the landfill received between 2,200 and 2,400 tons of waste per day, of which 8.5 tons per day came from Cape Canaveral AS. The Brevard County Landfill has a 10- to 12-year life expectancy. Cape

Canaveral AS also operates an on-site landfill that accepts construction and demolition debris and asbestos-containing material. The landfill has a capacity of 182 acres but currently uses only 55 acres. Of the remaining 127 acres, there are 7 acres of permitted capacity for construction and demolition debris disposal. In 1995, Cape Canaveral AS disposed of approximately 2,085 tons of construction and demolition debris, 25,546 tons of concrete, and 748 tons of asbestos-containing material.

3.5.1.4 Electricity. In 1995, approximately 220,000 megawatt-hours per day (MWH/day) were delivered to Brevard County, of which 864 MWH/day were consumed by Cape Canaveral AS. Transmission lines enter the station at three locations: the southwestern boundary; across the NASA Causeway; and from Merritt Island. The capacity of the three substations is 55 megawatts (MW); the substations are capable of providing 1,320 MWH/day. There are also 170 substations on Cape Canaveral AS that convert the voltage to user voltages.

3.5.2 Vandenberg AFB

Potable water, wastewater, solid waste, and electrical systems for Vandenberg AFB and the surrounding area are discussed in this section.

3.5.2.1 Water. The ROI for water supply and distribution consists of the Lompoc and Santa Maria valleys. Water supplies in these areas are provided by wells located in the Santa Ynez, San Antonio Creek Valley, and Santa Maria watersheds. In 1997, Vandenberg AFB was connected to the State Water Project for supplemental water supply. A maximum of 5,000 acre-feet per year may be obtained through the base's entitlement rights. The total potable water consumption in the ROI was approximately 33.9 MGD in 1995.

Water on Vandenberg AFB is supplied from the San Antonio Aquifer and the Lompoc Terrace Groundwater Basin. The main portion of the water supply delivered to North Vandenberg AFB comes from the western portion of the San Antonio aquifer. The total potable water supplied from this aquifer in 1995 was approximately 3.22 MGD. South Vandenberg AFB obtains water from the Lompoc Terrace Groundwater Basin. The water supplied from this aquifer in 1995 was approximately 0.20 MGD. In 1995, the combined potable water use for Vandenberg AFB was approximately 3.42 MGD.

3.5.2.2 Wastewater. The Lompoc Regional WWTP services the city of Lompoc, Vandenberg AFB, and portions of the surrounding areas. In 1996, Vandenberg AFB contributed approximately 1.29 MGD of wastewater to the Lompoc Regional WWTP. The capacity of the Lompoc Regional WWTP is 5 MGD.

Industrial wastewater generated during launch processing operations on Vandenberg AFB is treated at the Industrial Wastewater Treatment Plant (IWTP) on South Vandenberg AFB. The IWTP was constructed in the mid-1980s to treat wastewater generated as a result of space shuttle launch activities from SLC-6 but now handles all industrial wastewater from launch processes. The operable units of the IWTP include the ultraviolet (UV)/ozone system, the storage/distribution system, and the evaporation ponds. Currently, only one pond is utilized, pending completion of the engineering

analysis for integrity. Depending on the contents of the wastewater, the water is either taken to the UV/ozone system or to the evaporation ponds. Hydrazine-contaminated wastewater must first be processed in the UV/ozone system. Prior to transfer to the evaporation ponds, the water is sampled, characterized, and reviewed to ensure that it meets industrial wastewater criteria. The wastewater is transported via truck from the origination point to the IWTP.

Two tanker trucks, each with a maximum capacity of 5,000 gallons, operate over steep grades and travel up to 25 miles from the source of origin. The horsepower-to-weight ratio of the trucks limits the amount of wastewater per load to 2,000 to 4,000 gallons.

In 1996, the IWTP processed over 675,000 gallons of industrial wastewater, of which approximately 125,000 gallons required treatment for hydrazine at the UV/ozone system. Approximately 90 percent of the industrial wastewater originated at SLC-2, SLC-3, and SLC-4, and the hypergolic storage facility. Launches projected for 1997 are expected to produce over 1 million gallons of wastewater to be treated.

The IWTP capacity is limited to evaporation from the two lined surface impoundments. Each pond has a capacity of approximately 477,000 gallons at the 12-inch level and approximately 973,000 gallons at the 24-inch level. The evaporation rate for each pond varies from approximately 910 gpd during the winter to over 11,240 gpd during the summer. The standard operating depth is 12 inches; however, the ponds are frequently filled to 20 inches due to limited storage capacity. At this depth, spillage can occur from wind blowing across the ponds. Several instances of spills occurred during the 1994-1995 operating year, resulting in non-compliance issues. Currently, the IWTP operates at or above capacity during the rainy season. Wastewater is anticipated to increase as much as 100 percent over the next 3 years, exceeding plant capacity, as the ponds were not designed to handle the entire installation's industrial wastewater.

Vandenberg AFB is currently developing plans for construction of a closed-loop on-site water reclamation unit for each of the SLCs. The recycled industrial launch water could be reused for future launches instead of drawing from the potable water supply. A pilot project, identified under a joint DoD and U.S. EPA water quality initiative, is currently awaiting approval and funding. In the interim, Vandenberg AFB is researching measures that can be used to manage the treatment of industrial wastewater at the IWTP.

3.5.2.3 Solid Waste. Solid waste generated by Vandenberg AFB is disposed of in the on-base Class III landfill. Vandenberg AFB owns and operates the 187-acre landfill, about 4 miles north of Lompoc. In 1995, 60.3 tons per day were disposed of in the landfill, which has a life expectancy of 75 years.

3.5.2.4 Electricity. Electricity is provided by Pacific Gas and Electric Company's Morro Bay plant to Vandenberg AFB's main substation, then distributed through the base distribution system. The base also maintains diesel-powered generators to support technical facilities. In 1995, approximately 452 MWH/day were consumed by Vandenberg AFB.

3.6 HAZARDOUS MATERIALS AND HAZARDOUS WASTE MANAGEMENT

The relevant aspects of hazardous materials/waste management include the applicable regulations and procedures for hazardous materials usage and hazardous waste generation, and management programs for existing hazardous waste-contaminated sites within the ROIs.

3.6.1 Regulatory Framework

3.6.1.1 Hazardous Materials Management. Hazardous materials are those substances defined as hazardous by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 U.S.C. Sections 9601-9675), the Toxic Substances Control Act (TSCA) (15 U.S.C. Sections 2601-2671), and the Hazardous Materials Transportation Act (HMTA) (49 U.S.C. Section 1801, Parts 172-173). In general, this includes substances that, because of their quantity, concentration, or physical, chemical, or infectious characteristics, may present substantial danger to public health or welfare, or to the environment, when released. Air Force Instruction (AFI) 32-7086, *Hazardous Materials Management*, establishes procedures and standards that govern management of hazardous materials on Air Force installations.

3.6.1.2 Hazardous Waste Management. Management of hazardous waste must comply with the Resource Conservation and Recovery Act (RCRA), as amended by the Hazardous and Solid Waste Amendments of 1984 (HSWA) (42 U.S.C. Sections 6901-6992), which is administered by the U.S. EPA, unless otherwise exempted through CERCLA actions. Title C Part 261 identifies which solid wastes are classified as hazardous waste. RCRA requires that hazardous wastes be treated, stored, and disposed of to minimize the present and future threat to human health and the environment. Air Force guidance in AFI 32-7042, *Solid and Hazardous Waste Compliance*, provides a framework for complying with environmental standards applicable to hazardous waste.

3.6.1.3 Pollution Prevention. The federal Pollution Prevention Act (PPA) of 1990 established pollution prevention as a national objective. Air Force Policy Directive (AFPD) 32-70, Environmental Quality, outlines the Air Force policy for pollution prevention and references AFI 32-7080, *Pollution Prevention Program*, which defines the Air Force's Pollution Prevention Program requirements. AFI 32-7080 instructs all Air Force installations to implement a hierarchy of actions into daily operations to reduce the use of hazardous materials and the release of pollutants into the environment. The hierarchy of actions to prevent pollution is as follows: source reduction, waste reuse, waste recycling and, as a final option, waste disposal.

3.6.1.4 Installation Restoration Program. The IRP is an Air Force program that identifies, characterizes, and remediates past environmental contamination on Air Force installations. The program has established a process to evaluate past disposal sites, control the migration of contaminants, and control potential hazards to human health and the environment. In response to CERCLA and Section 211 of Superfund Amendments and Reauthorization Act (SARA) requirements, DoD established the Defense

Environmental Restoration Program (DERP) to facilitate clean up of past hazardous waste disposal and spill sites nationwide. Section 105 of SARA mandates that response actions follow the National Oil and Hazardous Substances Pollution Contingency Plan, as promulgated by the U.S. EPA. AFI 32-7020, The Environmental Restoration Program, implements the DERP as outlined in DoD Manual 5000.52-M, Environmental Restoration Program Manual.

The following subsections discuss specific programs for management of hazardous materials, hazardous waste, pollution prevention, and IRP sites at Cape Canaveral AS and Vandenberg AFB. The ROI for hazardous materials and hazardous waste management at both installations encompasses all geographic areas that are exposed to the possibility of a release of hazardous materials or hazardous wastes.

3.6.2 Cape Canaveral AS

The ROI for Cape Canaveral AS includes the areas around SLC-41 and SLC-37 and areas adjacent to proposed EELV facility locations.

3.6.2.1 Hazardous Materials Management. Numerous types of hazardous materials are used to support the various missions and general maintenance operations at Cape Canaveral AS. These materials range from common building paints to industrial solvents and hazardous fuels. Hazardous materials used to support current launch vehicle system activities (Atlas IIA, Delta II, Titan IVB) are presented in Tables 3.6-1, 3.6-2, and 3.6-3.

Table 3.6-1. Hazardous Materials Utilized Per Launch, Atlas IIA

Hazardous Material	Quantity (lbs)
POL	4,160
VOC-Based Primers, Topcoats, and Coatings	480
Non-VOC-Based Primers, Topcoats, and Coatings	2,800
VOC-Based Solvents and Cleaners	1,130
Non-VOC-Based Solvents and Cleaners	600
Corrosives	5,500
Refrigerants	0
Adhesives, Sealants, and Epoxies	2,540
Extremely Hazardous Substances (not otherwise included)	0
Other	460
Total	17,670

Note: Propellant quantities are listed in Table 2.2-2.
lbs = pounds
POL = petroleum, oil, and lubricants
VOC = volatile organic compound

Source: Lockheed Martin, 1997

A separate hazardous materials pharmacy distribution system (HazMart) has not yet been established or enforced at Cape Canaveral AS. Individual contractors at Cape Canaveral AS may obtain hazardous materials through their own organizations, local purchases, or other outside channels, although contractors are encouraged to obtain hazardous materials through the Patrick

AFB pharmacy whenever possible. Cape Canaveral AS is scheduled to implement a pharmacy system in 1998.

Management of hazardous materials, excluding hazardous fuels, is the responsibility of each individual or organization. The primary source for hazardous materials purchase and acquisition is through the Patrick AFB supply system. Patrick AFB implemented a HazMart for procurement,

Table 3.6-2. Hazardous Materials Utilized Per Launch, Delta II

Hazardous Material	Quantity (lbs)
POL	40
VOC-Based Primers, Topcoats, and Coatings	290
Non-VOC-Based Primers, Topcoats, and Coatings	230
VOC-Based Solvents and Cleaners	270
Non-VOC-Based Solvents and Cleaners	530
Corrosives	5,500
Refrigerants	0
Adhesives, Sealants, and Epoxies	340
Extremely Hazardous Substances (not otherwise included)	0
Other	10
Total	7,210

Note: Propellant quantities are listed in Table 2.2-2.
lbs = pounds
POL = petroleum, oil, and lubricants
VOC = volatile organic compound

Source: Boeing Company Response to Data Needs, 1997

Table 3.6-3 Hazardous Materials Utilized Per Launch, Titan IVB

Hazardous Material	Quantity (lbs)
POL	830
VOC-Based Primers, Topcoats, and Coatings	220
Non-VOC-Based Primers, Topcoats, and Coatings	40
VOC-Based Solvents and Cleaners	6,900
Non-VOC-Based Solvents and Cleaners	25,200
Corrosives	5,500
Refrigerants	60
Adhesives, Sealants, and Epoxies	290
Extremely Hazardous Substances (not otherwise included)	0
Other	160
Total	39,200

Note: Propellant quantities are listed in Table 2.2-2.
lbs = pounds
POL = petroleum, oil, and lubricants
VOC = volatile organic compound

Source: Lockheed Martin Environmental Analysis Report, 1997

storage, and distribution of hazardous materials. The purpose of the HazMart is to improve hazardous materials tracking and minimize hazardous waste generation by minimizing the use of hazardous materials. Under the HazMart concept, all hazardous materials are screened prior to being procured to

determine if less toxic alternative materials could be utilized during an industrial process. Under this system, only specific individuals within an organization can order and sign for hazardous materials.

Hazardous propellants are controlled by the Joint Propellants Contractor (JPC) for the 45 SW. The JPC handles the purchase, transport, temporary storage, and loading of hypergolic propellants and oxidizers.

Spills of hazardous materials are covered under 45 SW Operations Plan (OPlan) 32-3, Hazardous Materials Response Plan, which ensures that adequate and appropriate guidance, policies, and protocols regarding hazardous material incidents and associated emergency response are available to all installation personnel (45 Space Wing, 1996d).

3.6.2.2 Hazardous Waste Management. Hazardous waste management, including explosive ordnance disposal (EOD) at Cape Canaveral AS is regulated under the RCRA (Title 40 CFR 260-280) and the Florida Administrative Code (FAC) 62-730. These regulations are implemented through 45 SW OPlan 19-14, Petroleum Products and Hazardous Waste Management Plan, which addresses the proper identification, management, and disposition of hazardous waste on Cape Canaveral AS, and compliance with applicable federal, state, and Air Force requirements (45 Space Wing, 1996d).

All DoD-generated hazardous waste is labeled with the U.S. EPA identification number for Cape Canaveral AS, under which it is transported, treated, and disposed of. All individuals or organizations generating hazardous waste at Cape Canaveral AS are responsible for administering all applicable regulations and plans regarding hazardous waste. Generators must also comply with applicable regulations regarding the temporary accumulation of waste at the process site.

Cape Canaveral AS reported 513,507 pounds of DoD-generated hazardous waste in 1996. Typical hazardous wastes include various solvents, paints and primers, sealants, photo-developing solutions, adhesives, alcohol, oils, fuels, and various process chemicals. Hazardous wastes associated with current launch vehicle system activities are presented in Tables 3.6-4, 3.6-5, and 3.6-6. They are grouped by general description and the EPA-designated hazardous waste number.

Individual contractors and organizations maintain hazardous waste satellite accumulation points (SAPs) and 90-day hazardous waste accumulation areas in accordance with 45 SW OPlan 19-14. Cape Canaveral AS operates 40 SAPs. A maximum of 55 gallons per waste stream of hazardous waste can be accumulated at an SAP. There are currently 14 90-day accumulation areas on the station. There is no limit to the volume of waste that can be stored, but wastes must be taken to the permitted storage facility or disposed of off site within 90 days.

Table 3.6-4. Hazardous Waste Generated Per Launch, Atlas IIA

RCRA Hazardous Waste	Quantity (lbs)
Ignitable (D001) RCRA Wastes	3,270
Halogenated Solvents (F001/F002) RCRA Wastes	0
Non-Halogenated Solvents (F003/F004/F005) RCRA Wastes	0
Toxic (D004) EPA Wastes	40
Commercial Chemical Products (U) RCRA Wastes	380
Corrosive (D002) RCRA Wastes	5,500
Acutely Hazardous (P) RCRA Wastes	0
Reactive (D003) RCRA Wastes	0
State-Regulated Wastes	0
Miscellaneous Wastes	50
Total	9,240

EPA = Environmental Protection Agency
lbs = pounds
RCRA = Resource Conservation and Recovery Act

Source: Lockheed Martin Response to Data Needs, 1997

Table 3.6-5. Hazardous Waste Generated Per Launch, Delta II

RCRA Hazardous Waste	Quantity (lbs)
Ignitable (D001) RCRA Wastes	2,380
Halogenated Solvents (F001/F002) RCRA Wastes	0
Non-Halogenated Solvents (F003/F004/F005) RCRA Wastes	440
Toxic (D004) EPA Wastes	850
Commercial Chemical Products (U) RCRA Wastes	220
Corrosive (D002) RCRA Wastes	5,500
Acutely Hazardous (P) RCRA Wastes	0
Reactive (D003) RCRA Wastes	10
State-Regulated Wastes	5,240
Miscellaneous (Remediation) Wastes	2,170
Total	16,810

EPA = Environmental Protection Agency
lbs = pounds
RCRA = Resource Conservation and Recovery Act

Source: U.S. Air Force, 1994b

Table 3.6-6. Hazardous Waste Generated Per Launch, Titan IVB

RCRA Hazardous Waste	Quantity (lbs)
Ignitable (D001) RCRA Wastes	5,990
Halogenated Solvents (F001/F002) RCRA Wastes	430
Non-Halogenated Solvents (F003) RCRA Wastes	70
Toxic (D004) EPA Wastes	2,200
Commercial Chemical Products (U) RCRA Wastes	0
Corrosive (D002) RCRA Wastes	5,500
Acutely Hazardous (P) RCRA Wastes	0
Reactive (D003) RCRA Wastes	20,000
State-Regulated Wastes	2,000
Miscellaneous Wastes	0
Total	36,190

EPA = Environmental Protection Agency
lbs = pounds
RCRA = Resource Conservation and Recovery Act

Source: U.S. Air Force, 1988e

The permitted storage facility (RCRA Part B Permit, Number HO01-255040) is operated within Buildings 44200/44205. The facility is permitted to store hazardous wastes for up to 1 year under the current Florida Department of Environmental Protection (FDEP) permit and is operated by the Launch Base

Support (LBS) contractor. The waste storage site facility is not permitted to store waste hydrazine, MMH, or N_2O_4.

The JPC is responsible for the collection and transportation of hazardous waste (including propellant waste) from accumulation sites to a 90-day hazardous waste accumulation area, to the permitted hazardous waste storage facility, or to a licensed, permitted disposal facility off station. The Defense Reutilization and Marketing Office (DRMO) is responsible for managing and marketing excess and recoverable products and waste materials in accordance with applicable regulations. Hazardous items that cannot be managed by the DRMO are disposed of as hazardous wastes.

Waste deluge water that has been used for fire and sound suppression is discharged into percolation ponds adjacent to the launch pads or pumped to the WWTP for treatment (see Section 3.5.1.2). Groundwater monitoring wells are sampled quarterly in accordance with permit requirements.

3.6.2.3 Pollution Prevention. The 1996 45 SW Pollution Prevention Program Guide (PPPG) and Pollution Prevention Management Action Plan (PPMP) satisfy requirements of the Pollution Prevention Act of 1990. The PPPG also complies with requirements in DoD Directive 4210.15, AFI 32-7080, and the Air Force Installation PPPG. The PPPG establishes the overall strategy, delineates responsibilities, and sets forth specific objectives for reducing pollution of the ground, air, surface water, and groundwater. The purpose of the PPPG is to provide sufficient guidance for pollution prevention management on Patrick AFB and Cape Canaveral AS. Specific goals include implementation of management practices that eliminate or reduce the use of hazardous materials, increase efficiency in the use of raw materials, protect natural resources, and encourage source reduction through recycling, treatment, and disposal practices.

3.6.2.4 Installation Restoration Program. The IRP efforts at Cape Canaveral AS have been conducted parallel with the program at Patrick AFB and in close coordination with the U.S. EPA and the FDEP. Cape Canaveral AS is not a National Priorities List (NPL) site. The IRP sites are remediated under RCRA regulations in lieu of CERCLA.

Contamination has been confirmed at 63 IRP sites. Of the 63 IRP sites, 22 have regulatory concurrence for closure (No Further Response Action Planned [NFRAP]) or require monitoring only, 24 remain under investigation, and 17 are petroleum-contaminated sites. The identification of areas contaminated by petroleum is separate from that performed for IRP sites. This is a specific requirement under the FDEP's Petroleum Contamination Assessment (FAC 62-770 protocols). Of the 17 petroleum-contaminated sites, 7 are in remedial action phases and 10 are proposed for closure or have already been closed with regulatory approval. Cape Canaveral AS also has identified 46 areas of concern (AOCs). Of the 46 AOCs identified, 4 are currently proposed for NFRAP and 22 have been closed with regulatory approval.

The following discussion focuses on EELV activities at Cape Canaveral AS that have the potential to affect the ongoing investigations of IRP and AOC sites.

Concept A ROI

SLC-41. IRP Site DP-24 (Solid Waste Management Unit [SWMU] C047) is present at SLC-41. Hydrazine, diesel fuel, halogenated solvents, paints, thinners, trace metals, and waste oils may have been disposed of at the site. A RCRA Facility Investigation (RFI) has been conducted at this site.

In October 1996, an estimated 150,000 tons of polychlorinated biphenyl (PCB)-contaminated soil were identified at SLC-41. Approximately 25 percent of the contaminated soil was identified as containing PCB concentrations exceeding the regulated level of 50 ppm PCBs. The state of Florida regulates cleanup for industrial sites with contamination levels greater than 3 ppm.

Other EELV Facilities. IRP Site DP-60 (SWMU C095) is associated with Building 70500. Groundwater contamination may be present from past operations that required the use of solvents, oils, acids, and metals. Remedial investigation is in progress.

Concept B ROI

SLC-37. IRP Site C-L37 (SWMU 56) is present at SLC-37. This site consists of several areas where hydrazine, diesel fuel, RP-1, hydrocarbons, PCBs, solvents, and waste oils may have been disposed of. The site is currently undergoing a preliminary assessment/site investigation (PA/SI) under the IRP. As the sole user of SLC-37, NASA is currently investigating this site. Investigations will be conducted to determine whether a groundwater contamination plume underlies SLC-37. The AFSPC and NASA will determine what agency is ultimately responsible for site remediation.

3.6.3 Vandenberg AFB

The ROI for Vandenberg AFB includes the areas around SLC-3W and SLC-6, and areas adjacent to proposed EELV facility locations.

3.6.3.1 Hazardous Materials Management. Numerous types of hazardous materials are used to support the various missions and general maintenance operations at Vandenberg AFB. Hazardous materials utilized during current launch vehicle system activities are presented in Tables 3.6-1, 3.6-2, and 3.6-3. Vandenberg AFB requires all contractors using hazardous materials to submit a hazardous materials contingency plan prior to working on base.

In 1994, Vandenberg AFB implemented a HazMart (see Section 3.6.2.1). Distribution of hazardous materials is coordinated from a single issue point (Building 8317). Any unused materials are returned to the HazMart for reissue to another organization. Presently, all Air Force organizations participate in the HazMart, but contractor involvement is limited. Management of hazardous materials obtained directly from off-base suppliers by contractors is the responsibility of the individual contractor. The HazMart may be available to all base contractors.

Hazardous propellants for the 30 SW are controlled by United Paradyne, which handles the purchase, transport, temporary storage, and loading of hypergolic fuels and oxidizers. They are stored at the Hypergolic Storage Facility (Buildings 974 and 975) on South Vandenberg AFB.

Spills of hazardous materials are covered under the Hazardous Materials Emergency Response Plan, 30 SW Plan 32-4002, which ensures that adequate and appropriate guidance, policies, and protocols regarding hazardous material incidents and associated emergency response are available to all installation personnel.

3.6.3.2 Hazardous Waste Management. Hazardous wastes at Vandenberg AFB are regulated by RCRA (Title 40 CFR 260-280) and the California Environmental Protection Agency, Department of Toxic Substances Control, under the California Health and Safety Code, Title 22 Division 20, Chapter 6.5, Sections 25100 through 25159, and the California Administrative Code, Sections 25100 through 67188. These regulations require that hazardous waste be handled, stored, transported, disposed of, or recycled according to defined procedures.

The Vandenberg AFB Draft Hazardous Waste Management Plan (HWMP), 30 SW Plan 32-7043-A, implements the above regulations and outlines the procedures for disposing of hazardous waste. Implementing the procedures outlined in this plan ensures the proper identification, management, and disposition of hazardous waste on Vandenberg AFB, and compliance with applicable federal, state, and Air Force requirements.

All hazardous waste generated is labeled with the U.S. EPA identification number for Vandenberg AFB, under which it is transported, treated, and disposed of. All individuals or organizations at Vandenberg AFB are responsible for administering all applicable regulations and plans regarding hazardous waste, and for complying with applicable regulations regarding the temporary accumulation of waste at the process site.

Vandenberg AFB generated 2,008,174 pounds of hazardous waste in 1996. Typical hazardous wastes include various solvents, paints and primers, sealants, photo-developing solutions, adhesives, alcohol, oils, fuels, and various process chemicals. Hazardous wastes associated with current launch vehicle system activities are presented in Tables 3.6-4, 3.6-5, and 3.6-6. Hazardous waste is stored at its point of origin until the waste container is full, or until 60 days following the day the container first received waste (whichever is first). The waste is then transported to the permitted consolidated Collection Accumulation Point (CAP) for temporary storage for no longer than 30 days. Waste hypergolic fuel is stored at a separate consolidated Hypergolic Storage Facility CAP managed by United Paradyne. Consolidation of CAP functions helps to ensure that all legal requirements are met before transporting hazardous waste to the permitted storage facility.

Hazardous waste can be stored at the permitted storage facility (Building 3300) for up to 1 year from the date of accumulation. The permitted storage facility, operated by the DRMO, was issued a final RCRA Part B permit in 1996. DRMO serves as the agent to receive and store specified hazardous wastes and make arrangements for removal to off-base treatment, storage, or

disposal facilities (TSDFs) in compliance with “cradle to grave” RCRA management requirements. Wastes not listed in the Part B permit must be shipped to an off-base TSDF prior to the 90-day storage limit.

Waste deluge water that has been used for fire and sound suppression is collected and tested by the Vandenberg AFB Aerospace Fuels Lab. If the water is not found to be hazardous, it is sent to the base IWTP. Hazardous wastewater is characterized in accordance with California Title 22, Section 66261 requirements and sent to the CAP.

The base has been working with the regulators to implement a Water Quality Initiative. The system would implement a closed-loop recycling process at the major launch complexes (see Section 3.5.2.2.)

3.6.3.3 Pollution Prevention. The 1996 Vandenberg AFB PPMP, 30 SW Plan 32-7080, satisfies requirements of the Pollution Prevention Act of 1990 (U.S. Air Force, 1996b). The PPMP also complies with requirements in DoD Directive 4210.15, AFI 32-7080, and the Air Force Installation PPPG. The PPMP establishes the overall strategy, delineates responsibilities, and sets forth specific objectives for reducing pollution of the ground, air, surface water, and groundwater. The purpose of the PPMP is to provide sufficient guidance for pollution prevention management on Vandenberg AFB. Specific goals include implementation of management practices that eliminate or reduce the use of hazardous materials, increase efficiency in the use of raw materials, protect natural resources, and encourage source reduction through recycling, treatment, and disposal practices.

3.6.3.4 Installation Restoration Program. Vandenberg AFB is not listed on the NPL. IRP sites at Vandenberg AFB are being addressed in a manner generally consistent with the CERCLA process.

As of the end of 1996, 36 IRP sites were in the remedial investigation/ feasibility study (RI/FS) stage including those undergoing Interim Remedial Actions (IRAs). In addition, 40 sites are in the Remedial Action (RA) phase. Sixty sites have been recommended for NFRAP, with state concurrence.

Additionally, 166 AOCs at Vandenberg AFB were identified in the Supplemental Preliminary Assessment Report (U.S. Air Force Space Command, 1995c). Of the 166 AOCs, 2 were identified as areas of special handling. The AOCs are currently in the site investigation (SI) phase to determine whether contamination is present. Additional assessment efforts will be undertaken by Vandenberg AFB to ascertain the potential environmental concerns associated with these areas. The AOCs will be further investigated and remediated, if required.

The following discussion focuses on proposed EELV activities at Vandenberg AFB that have the potential to affect IRP and AOC sites.

Concept A ROI

SLC-3W. IRP Site 6 (SLC-3W) is at the northwestern end of Alden Road at SLC-3W. Hazardous substances that may have been released include RP-1, UDMH, component flushing solvents (trichloroethylene [TCE], methylene

chloride, and isopropyl alcohol), diesel fuel, waste oil, trace metals in deluge water, and paint residue in sandblast grit. In 1990, initial soil sampling was conducted at the site, and follow-up sampling was conducted in 1992. Based on the sampling results, IRP Site 6 was recommended for NFRAP, as all residual contaminants were found to be below levels that would pose an unacceptable risk to human health and the environment. A Preliminary Endangerment Assessment (PEA) report prepared for IRP Site 6 recommended that a NFRAP decision document be prepared and submitted for regulatory approval (Jacobs Engineering Group, Inc., 1995). The appropriate state agencies have concurred with the NFRAP finding. Any future environmental response actions will be conducted under the environmental compliance programs.

IRP Site 7 (Bear Creek Pond) is located west of Old Surf Road, just south of Bear Creek Pond. The pond area is the farthest downgradient portion of Bear Creek prior to Coast Road. At SLC-3E and SLC-3W, deluge water was released to Bear Creek Canyon. Contaminants of concern include hydrazine, solvents, lubricating oil, metals, and TCE. A Phase II RI Work Plan was completed for the site in 1996 to fill gaps identified in the Phase I data. Phase II RI field sampling and analyses are expected to be completed by the end of 1997.

Two AOCs associated with the SLC-3 area were identified during the PA/SI. AOC-66 is located at Building 765, a missile/space research facility with a substation and a transformer with detectable levels of PCBs. AOC-91, a 55-gallon waste oil drum, was associated with Building 780, the Water Pump House. The drum has been removed under a compliance removal action.

Other EELV Facilities. Building 7525, the Rocket Processing Building, is associated with AOC-143. In the past, a mixture of TCE and water was disposed of to grade. Currently, the building includes a paint spray booth, a hydraulic pumping station, and facilities for the use of solvents, photo-processing chemicals, and Freon.

Concept B ROI

SLC-6. There are no IRP sites located at SLC-6. However, AOC-89 is associated with Buildings 390A, 390M, 390T, and 391 within the SLC-6 area. Building 390 is actually composed of several structures labeled 390A-390T. Building 390A was constructed as an MST for the Manned Orbital program in 1969. Both past and present hydraulic leaks have been noted at this facility. Building 390M, a blast deflector made of concrete, is located west of Building 390A. Both photochemical waste and industrial wastewater releases have occurred within this facility. Building 390T was constructed in 1968 as a contaminated fuel holding area. Although no spills have been documented at this facility, it fits the definition of a potential SWMU under RCRA. Currently, this AOC is being investigated further to determine whether remediation is required.

Other EELV Facilities. Building 836, the NASA Building, is associated with IRP Site 19. Waste oils and solvents generated from operations at Building 836 were reportedly disposed of in a drainage ditch south of the building. A

PEA report will be prepared for IRP Site 19. A TCE plume is present beneath the northeastern side of the building. Remediation of the plume should be completed by 2000.

3.7 HEALTH AND SAFETY

3.7.1 Regulatory Framework

The regulatory environment for health and safety issues consists of those regional and local elements that have been established to minimize or eliminate potential risk to the general public and on-site personnel as a result of operations. The ROI for health and safety includes the areas surrounding Cape Canaveral AS and Vandenberg AFB that could be affected by launch operations or a credible accident, and areas associated with the transportation of hazardous materials. Both Cape Canaveral AS and Vandenberg AFB have extensive experience in the operations associated with launch vehicles.

Range safety regulations at both Cape Canaveral AS and Vandenberg AFB are contained in EWR 127-1, Range Safety Requirements (U.S. Air Force, 1995a). The objective of the range safety program is to ensure that the general public, launch area personnel, foreign land masses, and launch area resources are provided an acceptable level of safety, and that all aspects of prelaunch and launch operations adhere to public laws. Range Safety reviews, approves, and through operation safety, monitors and imposes safety holds, when necessary, on all prelaunch and launch operations conducted on the ranges. This is to ensure that hazards associated with propellant, ordnance, and other hazards do not expose the general public to risks greater than those considered acceptable by public law or state documents.

EWR 127-1 is divided into seven chapters that address all aspects of range safety. Range safety is the responsibility of all 45 and 30 SW organizations, tenants, contractors, subcontractors, range users, and visitors to the ranges. Active range safety involvement in a program from the earliest concept phases through launch enhances the chances for a safe program. To implement this, the Air Force has developed the "Concept to Launch" process, which identifies key safety milestones to ensure that all aspects of safety are addressed. This process for new launch programs includes an introduction to range safety, tailoring of EWR 127-1 for specific program requirements, noncompliance resolution, flight analysis review, launch vehicle elements and ground support equipment design review, airborne range safety system review, facility design review, operation test review, final range safety approval for launch operations, safety critical launch operations, and final range safety clear to launch. These safety reviews are applicable to the launch vehicle, payload, support equipment, and facilities. The safety review procedure provides a means of substantiating compliance with program safety requirements and encompasses all systems analyses and testing as required by the DoD. Major safety documents must be prepared to meet the requirements of EWR 127-1. Among these documents are the following:

Toxic Release Contingency Plan (TRCP). The TRCP may have to be updated to include program-specific launch vehicle, payload, ground-support equipment, and facility toxic material (propellants) at the ER, and Toxic Hazard Assessments (THA) at the WR. THAs are conducted to develop and control Toxic Hazard Zones (THZ) for each launch. THAs provide the appropriate safety clear areas for the storage, handling, and transfer of propellants; they also provide for protection of workers and the general public during vehicle processing and launch operations. The TRCP and THA must be updated prior to loading or storing the program toxic materials.

Explosive Quantity-Distance Site Plan. This site plan must be generated or updated for facilities used to store, handle, or process ordnance items or propellants. AFM 91-201, Explosive Safety Standards, and DOD-STD-6055.9, Ammunition and Explosives Safety Standards, are the governing documents for explosive siting. DoD Explosive Safety Board approval of this plan is required prior to construction of new facilities, and prior to the arrival of ordnance and propellants.

Hazardous materials such as propellant, ordnance, chemicals, and booster/payload components are transported to both ranges in accordance with DOT regulations for interstate shipment of hazardous substances (Title 49 CFR 100-199). Hazardous materials such as liquid rocket propellant are transported in specially designed containers to reduce the potential of a mishap should an accident occur. For some hazardous materials, each state may have its own required transportation routes, time of shipments, and permits. To date, no major accidents involving the shipment of hazardous materials associated with launch vehicles have occurred.

3.7.2 Cape Canaveral AS

3.7.2.1 Regional Safety. The range contractor at Cape Canaveral AS, the city of Cape Canaveral, Brevard County, and the KSC have a mutual-aid agreement in the event of an on- or off-station emergency. Each organization may request equipment and manpower in the event of a fire or other emergency. Current procedures mandate that a representative of the Brevard County Emergency Management Staff sit in the ROCC during all launches (Wadzinski, 1997). Consequently, Brevard County Emergency Management can better respond to a launch emergency through improved communications with Cape Canaveral AS staff.

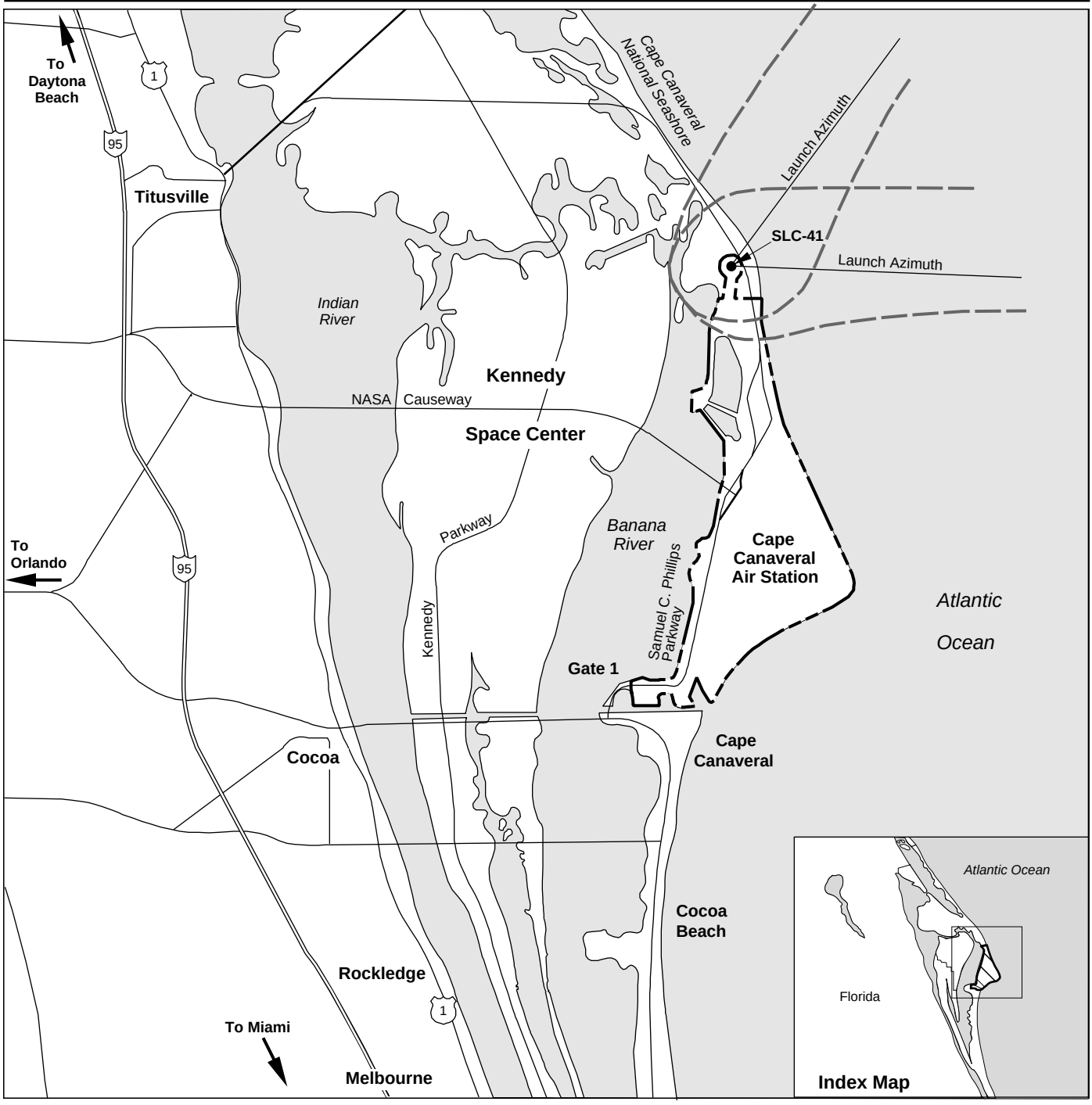
Prior to a launch, the 45 SW uses an air dispersion computer model to predict toxic plume concentrations and locations for normal and failure launch modes. A detailed description of the computer model is discussed in Section 3.7.2.2, On-Station Safety. During launch activities, communication is maintained with Brevard County Emergency Management, KSC, the Florida Marine Patrol, the U.S. Coast Guard, and the State Warning Point, Division of Emergency Management, in Tallahassee, Florida. Additionally, real-time video and audio of all launches are provided to all off-station agencies. Currently, in addition to the facsimiles discussed above, the 45 SW transmits facsimiles of general messages that describe plume effects and general emergency response procedures.

At the ER, Range Safety monitors launch surveillance areas to ensure that risks to people, aircraft, and surface vessels are within acceptable limits. Control areas and airspace are closed to the public as required. 45 SW Flight Analysis notifies the 45 Range Squadron prior to launch of the areas that are hazardous to aircraft (i.e., impact debris corridor). The 45 Range Squadron is responsible for disseminating a Notice to Airmen through the FAA, Miami Air Route Traffic Control Center. 45 SW also ensures that a Notice to Mariners within the impact debris corridor is disseminated beginning 10 working days prior to launch. The United States Coast Guard (USCG) transmits Marine radio broadcast warnings to inform vessels of the effective closure time for the sea impact debris corridor. In addition, warning signs are posted in various Port Canaveral areas for vessels leaving the port. Figures 3.7-1 and 3.7-2 present impact debris corridors for a typical launch from SLC-41 and SLC-37, respectively.

Impact Debris Corridors. Flight termination boundaries ("destruct lines"), which protect impact limit lines, are established for each flight. These boundaries are computed to minimize potential debris impact on populated areas resulting from destruct action. Debris impacts are contained within the impact limit lines because the flight would be terminated to protect the public if the launch vehicle violates the flight boundaries. Vehicle trajectory deviations, obvious erratic flight, or other flight termination criteria which are unique for a particular mission would trigger the flight termination action. A debris hazard exists for normal launches, which results primarily from jettisoned payload fairings, stages, and other launch vehicle components. These hazards are all contained within the impact limit lines and the nominal impact areas are identified through Notices to Airmen and Mariners.

3.7.2.2 On-Station Safety. Launches are not allowed if an undue hazard exists for persons and property due to potential dispersion of hazardous materials or propagation of blast. The 45 SW has prepared a Toxic Hazard Control Plan that details the procedures to be used to control heated toxic gas hazards.

An air dispersion computer model, the Rocket Exhaust Effluent Diffusion Model (REEDM) (Bjorklund, 1990), is run to predict THCs associated with launches. It can also predict toxic plume concentrations and locations resulting from an actual abort during launch. Inputs to this model include predicted meteorological conditions, including rawinsonde balloon (a meteorological balloon used to provide wind speed and other data in the upper atmosphere) data, probable failure modes, and solid/liquid propellant emission estimates from the launch vehicle and/or facility. REEDM produces outputs in terms of peak concentration, time-averaged concentration of user-inputted time interval, and dosage estimates as required for the exposure criteria for each chemical species being analyzed. Three types of THCs are supported using REEDM: the Potential Hazard Corridor for a planned credible failure mode, the Emission Hazard Corridor for nominal emissions, and the Operational Hazard Corridor resulting from a failure mode that has actually occurred.



EXPLANATION

Cape Canaveral AS Boundary

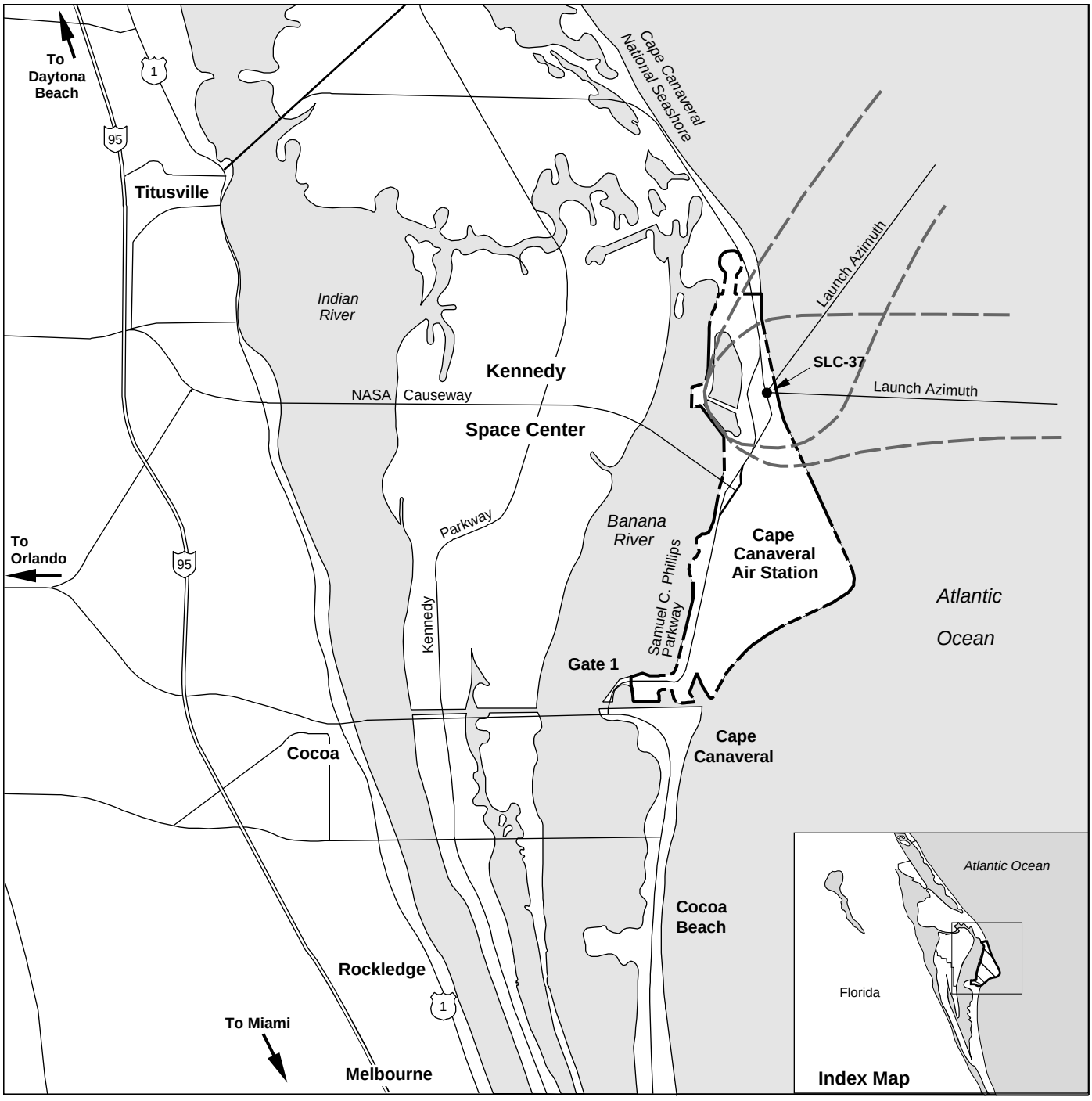
Impact Debris Corridor

Typical Impact Debris Corridors, SLC-41

0 1 2 4 Miles

Figure 3.7-1

EELV/117



EXPLANATION

Cape Canaveral AS Boundary

Impact Debris Corridor

Typical Impact Debris Corridors, SLC-37

0 1 2 4 Miles

Figure 3.7-2

EELV/117

THCs are predicted for launches to ensure that Cape Canaveral AS/KSC personnel and the general public will not be exposed to toxic gases that may adversely affect their health.

Headquarters AFSPC Surgeon General's Office (HQ AFSPC/SG) has made recommendations regarding exposure criteria for contaminant concentrations that are modeled by REEDM. These recommendations are currently under review by the National Academy of Science, National Research Council, Committee on Toxicology (NAS/NRC/COT). When the NAS/NRC/COT completes its review, the Air Force Surgeon General (AF/SG) will consider the NAS/NRC/COT recommendations for adoption as Air Force standards. The Air Force currently follows the HQ AFSPC/SG recommendations.

The HQ AFSPC/SG has recommended exposure criteria for HCl, nitrogen dioxide (NO_2), nitric acid (HNO_3), and various hydrazines. HCl criteria apply to chlorine (Cl_2), because Cl_2 is formed from HCl in the presence of water. HCl is the byproduct of combustion of solid fuel and is the primary hazard during normal launches with solid rocket motors (e.g., Titan IVB). During an abort, the primary health hazards are NO_2, HNO_3, and hydrazines (if hydrazines are used as liquid propellants), although HCl is present. NO_2 and HNO_3 are formed from nitrogen tetroxide N_2O_4 during fireball-type chemical reactions during a launch abort. N_2O_4 is carried in upper stages of a launch vehicle and only produces NO_2 and HNO_3 during an explosion caused by an abort.

Table 3.7-1 presents Tier 1, Tier 2, and Tier 3 recommended exposure criteria for HCl, NO_2, HNO_3, and various hydrazines. Through a comparison of predicted exposure concentrations to Tier 1, Tier 2, or Tier 3 exposure criteria, Systems Safety will arrive at specific risk management decisions to protect installation personnel and the public.

Prior to a launch, the air dispersion model Ocean Breeze Dry Gulf (OBDG), a model contained in the Meteorological and Range Safety Support (MARSS) System, is run to plot downwind concentrations of toxic gases during cold spills (i.e., spills or releases of toxic materials from storage tanks or that occur during loading or unloading of tanks).

The 45 Weather Squadron alerts Cape Canaveral AS as soon as possible concerning a potential hurricane strike. Cape Canaveral AS personnel are evacuated as appropriate according to updated weather information. All buildings, facilities, fuel handling systems, mobile launch support towers, and other above-ground structures have been constructed to withstand a wind velocity up to 105 miles per hour. Prior to a hurricane strike, launch vehicles are detanked and either transferred to an aboveground structure for protection or protected on the launch pad by enclosure within a mobile support tower.

Table 3.7-1. Exposure Criteria for Constituents in Rocket Motor Exhaust Plumes

	Tier 1[a]	Tier 2[b]	Tier 3[c]
HCl	2 ppm[d] (60 min) 10 ppm[e]	10 ppm[e]	50 ppm[e]
N_2H_4	NA	2 ppm (60 min)	50 ppm[d] (30 min)
UDMH	NA	5 ppm (60 min)	15 ppm[d](30 min)
A-50	NA	4 ppm[d] (60 min)	15 ppm[d](30 min)
MMH	NA	2 ppm (60 min)	20 ppm[d](30 min)
NO_2	0.2 ppm[d] (60 min) 2 ppm[e]	2 ppm[d] (60 min) 4 ppm[e]	20 ppm[d] (30 min)
HNO_3	0.3 ppm[e]	2.5 ppm[d] (60 min) 4 ppm[e]	25 ppm[d] (30 min)

Notes: (a) Tier 1—An airborne exposure level (maximum concentration) which poses no hazard to the general population but which may affect certain sensitive individuals (e.g., asthmatics, individuals with emphysema, and certain other lung-diseased people). An area where exposure levels equal or exceed Tier 1 exposure criteria, but do not exceed Tier 2 criteria, requires no controls.

(b) Tier 2—An airborne exposure level (maximum concentration) which may cause short-term symptoms but which most individuals could endure without experiencing or developing irreversible or other serious health effects or symptoms that could impair their ability to take protective action.

(c) Tier 3—An airborne exposure level (maximum concentration) that could cause irreversible health effects or impair one's ability to take protective action. Concentrations are immediately dangerous to life and health and pose significant risk to exposed individuals.

(d) Time-weighted average (TWA) exposure concentration. The time period indicated is the time over which the concentration measurements will be measured and averaged.

(e) Ceiling limit. A peak concentration that should not be exceeded during the exposure period.

A-50 = Aerozine-50 (50 percent by weight unsymmetrical dimethylhydrazine and anhydrous hydrazine)
HCl = hydrochloric acid
HNO_3 = nitric acid
min = minutes
MMH = monomethyl hydrazine
NA = not applicable
N_2H_4 = anhydrous hydrazine
NO_2 = nitrogen dioxide
ppm = parts per million
UDMH = unsymmetrical dimethylhydrazine

Emergency responses to major peacetime accidents and natural disasters are covered by 45 Space Wing Oplan 32-1, Volume II. Emergency responses involving hazardous materials are covered by 45 Space Wing Oplan 32-3, Volume I. The Launch Disaster Control Group (LDCG) is an emergency response team formed prior to each launch and situated at a fallback location

respond to launch accidents in order to save lives, protect property, control fires, limit the extent of damage, prevent adverse public relations, and return to normal launch operations as soon as possible after an accident. The Disaster Control Group (DCG) is an emergency response team that is activated for nonlaunch-related disasters at Cape Canaveral AS. The mission of the DCG is to minimize the loss of personnel and operational capability caused by wartime contingencies, peacetime disasters, and major accidents including those involving hazardous materials.

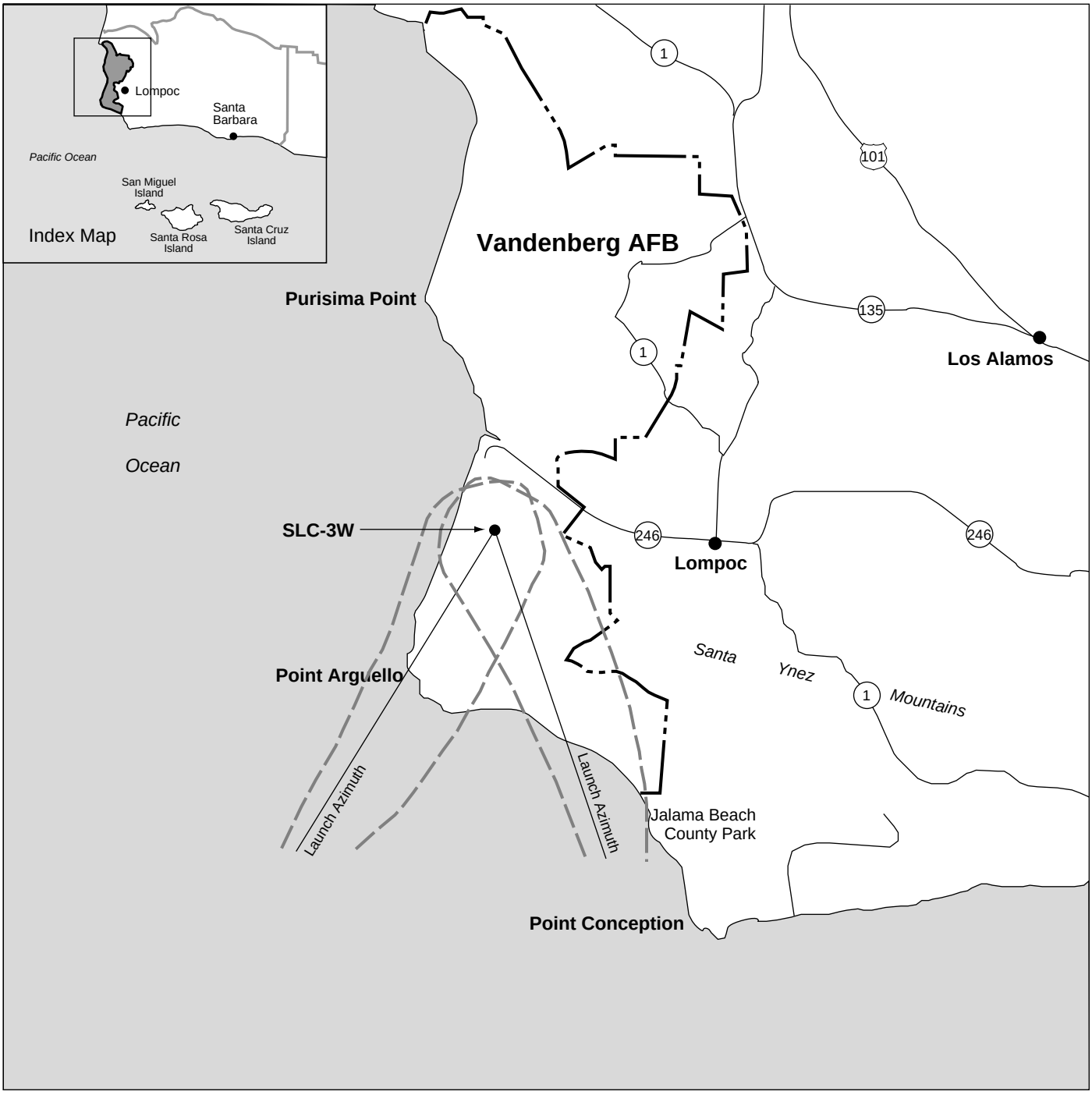
3.7.3 Vandenberg AFB

3.7.3.1 Regional Safety. Regionally, Santa Barbara County prepared a Hazardous Material Response Plan that is used for countywide disaster response. Cities and communities in the county are required to have their own emergency response plans that were incorporated by the county into a comprehensive Multihazard Functional Plan, which specifies actions to be taken in case of a local disaster. The city of Lompoc adopted its Multihazard Functional Plan in 1989 and amended it in 1994. Because of the potential for Vandenberg AFB operations to affect off-base areas, Vandenberg AFB plays a prime role in regional emergency planning (Environmental Science Associates, 1996; U.S. Air Force, 1989a).

The city of Lompoc and Vandenberg AFB have entered into a mutual aid agreement, which allows emergency units from either Lompoc or Vandenberg AFB to provide each other with assistance in the event of an emergency. A "hotline" exists between the city of Lompoc and Vandenberg AFB in order to immediately notify the city in case of a major accident on the base. In the event of an emergency involving a launch mishap in Lompoc, Vandenberg AFB would assume control and could set up a national defense area if protected material were involved in the accident.

In the event of a launch vehicle impacting other areas outside Vandenberg AFB, the On-Scene DCG from Vandenberg AFB would respond to the accident upon request of the county. County agencies would be used to help in the evacuation and possible fire control for such an incident. Military personnel would assume responsibility for disaster control in the immediate impact area.

Impact debris corridors have been established off the Santa Barbara County coast between Point Sal and Point Conception. These corridors were established to meet security requirements and reduce the hazard to persons and property during a launch-related activity. Impact debris corridors are established through the designation of debris impact areas for each specific launch. These corridors are plotted for all launches. Figures 3.7-3 and 3.7-4 present example impact debris corridors for a typical launch from SLC-3W and SLC-6, respectively.



EXPLANATION

Vandenberg AFB Boundary

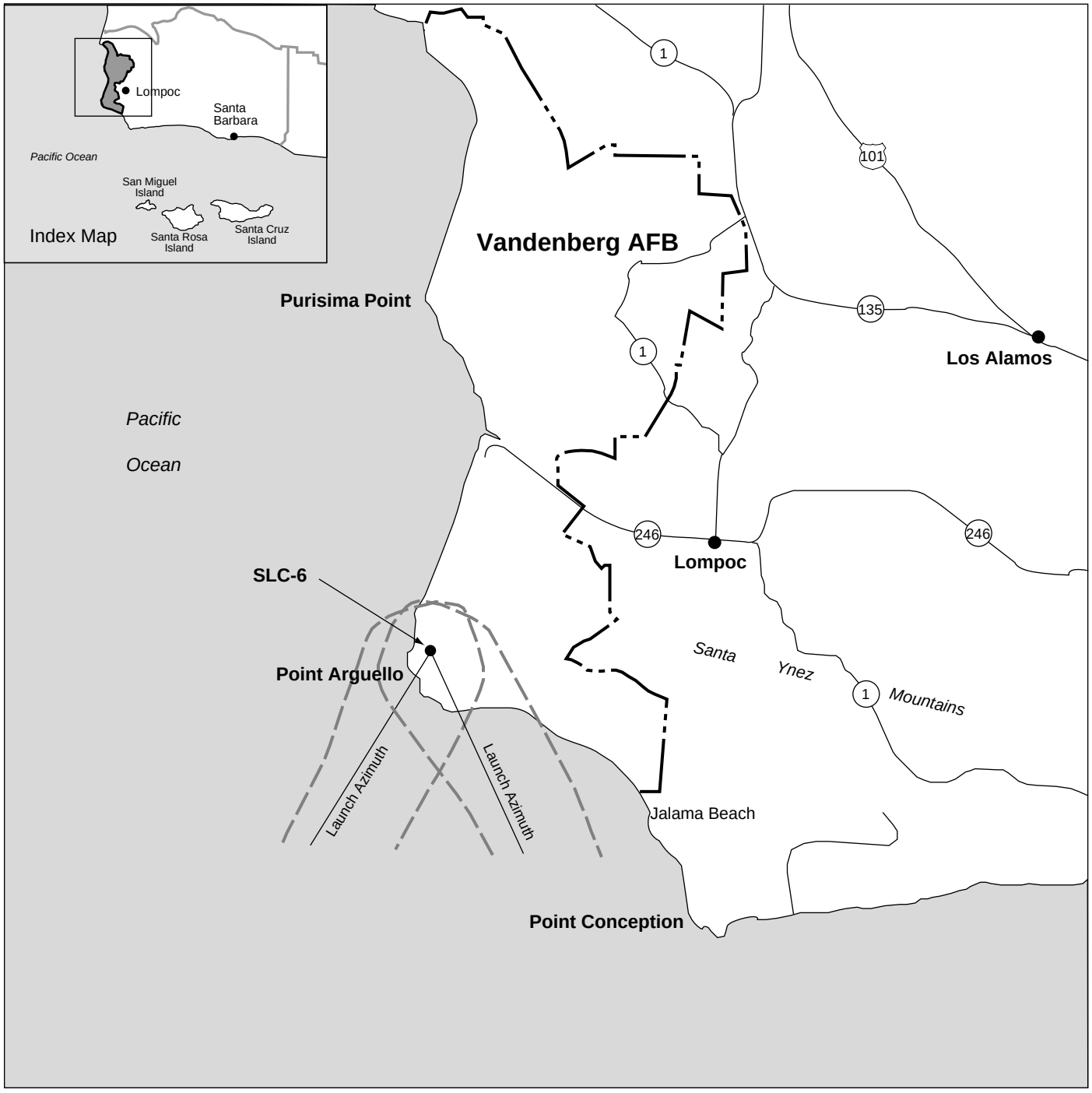
Impact Debris Corridor

Typical Impact Debris Corridors, SLC-3W

0 1.25 2.5 5 Miles

Figure 3.7-3

EEL/103



EXPLANATION

Vandenberg AFB Boundary

Impact Debris Corridor

Typical Impact Debris Corridors, SLC-6

0 1.25 2.5 5 Miles

Figure 3.7-4

EEL/105

Zone closures are announced daily over various radio frequencies and posted in harbors along the coast. 30 SW Flight Analysis notifies the 30 Range Squadron of areas that are hazardous to aircraft (i.e., impact debris corridors) for all normally jettisoned and impacting stages by 30 working days prior to launch. The 30 Range Squadron notifies the FAA, Los Angeles Center or Oakland Center, so that the information can be disseminated through a Notice to Airmen. 30 SW also ensures that a Notice to Mariners within the impact debris corridor is disseminated beginning 30 working days prior to launch. Information regarding impact debris corridors is distributed to surface vessels when the 30 SW sends written notification of impact debris corridors to be published weekly in the USCG Long Beach Broadcast to Mariners. Broadcasts by USCG Long Beach provide the latest available hazard information to offshore surface vessels.

30 SW has developed procedures related to evacuating or sheltering personnel on offshore oil rigs during launch operations. These procedures pertain to offshore platforms located west of 120 degrees 15 minutes longitude. The 30 SW Chief of Safety notifies 30 Range Squadron of future launches, and 30 Range Squadron notifies the Minerals Management Service (MMS), Department of the Interior, to notify oil rig personnel of a future launch. The MMS will first notify the oil rig operator 10 to 15 days before a launch to prepare for possible sheltering or evacuation. The second notice is given 24 to 36 hours before the launch confirming the requirement to shelter or evacuate. The third notice is given by Frontier Control to provide final notice before, during, and after securing the operation. Additional notices are sent as required. Oil rig operators are notified to shelter or evacuate personnel according to REEDM models of toxic vapor plumes and potential impact of launch debris.

Jalama Beach and Ocean Beach county parks are closed on the day of a launch from South Vandenberg AFB. The beaches are within the range safety zone that has been calculated for South Vandenberg AFB launches. Although direct overflight of the beaches does not normally occur, there is the possibility of debris from a launch anomaly impacting the beaches. In order to protect park visitors, Vandenberg AFB, the County Parks Department, the County Sheriff, and the California Highway Patrol have agreed to close the parks upon request during launches affecting the beaches.

3.7.3.2 On-Base Safety. As discussed in Section 3.7.2.2, launches are not allowed if an undue hazard exists to persons and property due to potential dispersion of hazardous materials or propagation of blast. The 30 SW runs REEDM before a launch to estimate THCs. A description of REEDM is provided in Section 3.7.1.2. The procedure to estimate risk to Vandenberg AFB personnel and the general public through comparison of THC exposure concentrations to exposure criteria is the same as described in Section 3.7.1.2. Other safety procedures are similar to those described in Section 3.7.1.2, with the exception of those safety procedures described below. The air dispersion models Mountain Iron and AFTOX are run to plot downwind concentrations of toxic gases during cold spills.

Launch vehicle mishaps (i.e., accidents involving any launch vehicle operation) are handled by various emergency support teams on base. Some of these procedures include authorization to enter an accident area, control

procedures for monitoring trains, and salvage procedures. Several distinct teams of qualified individuals are available to respond to emergencies that might occur during a launch. These teams include the Specialized Operation Support Team, the On-Scene Disaster Group, the Missile Potential Hazard Team, and the Launch Support Team.

The Southern Pacific Transportation Company (SPTC) railroad crosses Vandenberg AFB; SPTC owns the railroad property. Most launches fly over the railroad. 30 SW has procedures for train protection and subsequent "hold" or "proceed" decisions during launch operations.

Vandenberg AFB is located in Seismic Hazard Zone 4, which is the most severe seismic region. Consequently, the seismic design of all new or modified facilities, structures, and equipment shall be in accordance with all applicable Air Force standards (see Appendix E, Section 3.4.3.1). Equipment that has the potential to cause the following hazards must be designed to withstand an earthquake:

- Severe personal injury
- A catastrophic event
- Significant impact on space vehicle or missile processing and launch capability.

3.8 GEOLOGY AND SOILS

This section provides an overview of the physiography, geology, soils, and geologic hazards in the vicinity of Cape Canaveral AS and Vandenberg AFB. In general, the ROI is the regional geologic setting and the areas in the immediate vicinity of the launch complexes that could be affected by construction and launch operation activities.

3.8.1 Cape Canaveral AS

3.8.1.1 Geologic Setting. Cape Canaveral AS lies on a barrier island composed of relict beach ridges formed by wind and wave action. The island is 4.5 miles wide at its widest point. Its land surface ranges from sea level to 20 feet above mean sea level (MSL) at the harbor dredge disposal site near Port Canaveral. The average land surface elevation is approximately 10 feet above MSL. The higher naturally occurring elevations occur along the eastern portion of Cape Canaveral AS, with a gentle slope to lower elevations toward the marshlands along the Banana River.

The geology underlying Cape Canaveral AS can be generally defined by four stratigraphic units: the surficial sands, the Caloosahatchee Marl, the Hawthorn Formation, and the limestone formations of the Floridan aquifer (U.S. Air Force, 1991c). The surficial sands immediately underlying the surface are marine deposits that typically extend to depths of approximately 10 to 30 feet below the surface. The Caloosahatchee Marl underlies the surficial sands and consists of sandy shell marl that extends to a depth of 70 feet below the surface. The Hawthorn Formation, which consists of sandy limestone and clays, underlies the Caloosahatchee Marl and is the regional

confining unit for the Floridan aquifer. This formation is generally 80 to 120 feet thick, typically extending to a depth of approximately 180 feet below the surface (U.S. Air Force, 1991c). Beneath the Hawthorn Formation lie the limestone formations of the Floridan aquifer, which extend several thousand feet below the surface at Cape Canaveral AS (U.S. Air Force, 1991c).

The principal geologic hazard in central Florida is sinkholes that develop when overlying soils collapse into existing cavities. Cape Canaveral AS is not located in an active sinkhole area, and the review of topographic maps did not reveal the presence of any sinkholes. The Canaveral Peninsula is not prone to sinkholes, since the limestone formations are over 100 feet below the ground surface, and confining units minimize recharge to the limestone (45 Space Wing, 1996b).

A seismological investigation conducted by the U.S. Department of Commerce shows that the underground structure in the heavy launch area is free of anomalies, voids, and faults (45 Space Wing, 1995c). Cape Canaveral AS is located in Seismic Hazard Zone 0 as defined by the Uniform Building Code (International Conference of Building Officials, 1991). Seismic Zone 0 represents a very low potential risk for large seismic events.

3.8.1.2 Soils. The three most prominent soil types at Cape Canaveral AS comprise the Canaveral-Palm Beach-Welaka Association. This association is made up of nearly level and gently sloping ridges interspersed with narrow wet sloughs that generally parallel the ridges. The soils have rapid permeability and low available water capacity due to the near-surface water table. This permeability rate allows water to rapidly dissipate into the ground. According to the General Plan, limitations to development are slight to moderate for light industrial uses. No problems associated with previous construction activities at the SLCs have been identified. Soils in the areas of SLC-41 and SLC-37 are not considered highly suitable for commercial agricultural uses. There are no prime or unique farmland soils on Cape Canaveral AS (Pan Am World Services, Inc., 1989).

3.8.2 Vandenberg AFB

3.8.2.1 Geologic Setting. The region encompassing South Vandenberg AFB lies within the Transverse Ranges Physiographic Province of California and is dominated by the Santa Ynez Mountains. The Pacific Ocean and Santa Barbara Channel lie west and southeast, respectively, of the mountains, and the Lompoc-Santa Ynez River Valley lies to the north. Topography within Vandenberg AFB is varied, ranging from sea level to about 2,000 feet MSL in the Santa Ynez Mountains.

Locally, within the area incorporating South Vandenberg AFB, bedrock at the surface consists of diatomaceous shale that has an approximate thickness of 1,600 feet, known as the Upper Monterey Formation. Marine terrace deposits varying in thickness from a few to several tens of feet unconformably overlie the Monterey Formation. Weathered material 1 to 5 feet thick covers most of the slope areas that have low to moderate gradients.

Numerous onshore and offshore faults have been mapped within the vicinity of Vandenberg AFB; most are inactive and not capable of surface fault rupture or of generating earthquakes (U.S. Air Force, 1989a). Four faults have been mapped on Vandenberg AFB: the Lion's Head, Hosgri, Santa Ynez River, and Honda (U.S. Air Force, 1989d). The Lion's Head Fault runs through North Vandenberg AFB, and the Hosgri, Santa Ynez, and Honda faults run through South Vandenberg AFB. Of the three faults on South Vandenberg AFB, only the Hosgri Fault is considered to be active (ruptured in the last 10,000 years). The Santa Ynez River Fault is approximately one-half mile south of SLC-3W. The Hosgri Fault is located approximately 7.5 miles northwest of SLC-3W and 2.5 miles northwest of SLC-6. The Honda fault is the closest fault to SLC-6, which is approximately 1.5 miles north.

The secondary effects of fault rupture are earthquake ground motions, or seismicity. The Western Transverse Ranges, inclusive of the continental borderlands, have historically been in a moderately high seismic region. Since 1900, within a 20-mile radius of the project area, there have been over 90 earthquakes with magnitudes ranging from 3.0 to 7.3 (U.S. Air Force, 1989a). Two earthquakes were notable, one in 1812 (M7.1), most likely epicentered in the Santa Barbara Channel, and the other in 1927 (M7.3), offshore near Point Arguello. The 1927 event may have occurred less than 20 miles west of South Vandenberg AFB. Vandenberg AFB is located in a Seismic Zone IV, as defined by the Uniform Building Code (International Conference of Building Officials, 1991), characterized by areas likely to sustain major damage from earthquakes, and corresponds to intensities of VIII or higher on the Modified Mercalli Scale.

Shallow failures (i.e., 5 to 10 feet deep) such as slumps, rock falls, debris or mud flows and deep-seated landslides have not been identified in the immediate EELV project area locations. From a geologic standpoint, natural slopes on or adjacent to the area have been stable for many hundreds of years, although modifications to slopes, such as those that have occurred at SLC-6, may change slope conditions. Geotechnical investigations are conducted during engineering design to determine potential unstable conditions, and recommendations are made for safe slope design (U.S. Air Force, 1989a).

3.8.2.2 Soils. Soil deposits occur on most slopes and surfaces where bedrock is not exposed. The deposits were developed by weathering of the underlying Monterey Formation and/or terrace deposits. Soil thickness varies throughout the area but is generally less than 3 feet. Because of the slope of the terrain on South Vandenberg AFB, drainage (surface run off) and erosion affect local soils. Soils in the areas of SLC-3W and SLC-6 are not considered highly suitable for commercial agricultural uses. There are no prime or unique farmlands within proposed EELV operation areas at Vandenberg AFB.

Erosion of soils and bedrock materials is a continuing process caused by running water and wind. Soils within the area vary greatly, and those that are very sandy are more susceptible to erosion than are fine-grained deposits. Excessive erosion problems have occurred at several locations in the South Vandenberg AFB area, primarily associated with developed (graded) slopes (U.S. Air Force, 1989a). No problems associated with previous construction

activities at the SLCs have been identified. Developed slopes are often stabilized to prevent erosion.

In the vicinity of SLC-3W, the Lompoc Terrace is cut by Spring Canyon (directly south of SLC-4), Bear Canyon (between SLC-3 and SLC-4), and Lompoc Canyon (east of SLC-3). The valley floors of these canyons are approximately 100 to 300 feet below the surrounding terrace surface. The ground surface elevation at SLC-3W ranges from 400 to 500 feet above MSL. Slopes within the SLC-3W security fence are mild (less than 10-percent slope), except for the area southeast of the SLC-3E retention basin, where there are 25-percent slopes. Soils in the vicinity of SLC-3W have moderate to rapid permeability. The site is well vegetated, reducing the potential for surface erosion (Jacobs Engineering Group, Inc., 1995).

The SLC-6 site is located on an elevated marine terrace adjacent to the lower slopes of the Santa Ynez Mountains. Developed portions of the site have been graded and do not reflect the original topography. Adjacent undeveloped areas slope gently to the west with an average gradient of about 5 percent. The site lies generally between 200 and 500 feet above MSL, with a total relief of about 300 feet from west to east. The SLC-6 area is bounded on the north and south by two drainages. The southerly drainage extends from a large canyon east of the site to a discharge point about 1 mile to the northwest. The northerly drainage, known as Red Roof Canyon, extends from developed slopes of SLC-6 northwest, to a discharge point over 1 mile from the site. Both drainages have steep side slopes. Some erosion of soils is evident at points along the drainages bounding the SLC-6 site. The erosion potential of most on-site soils is severe. Slope stabilization measures have been implemented, especially adjacent to Red Roof Canyon, where excessive erosion required cement gunnite to protect graded slopes (U.S. Air Force, 1989a).

3.9 WATER RESOURCES

Water resources include groundwater and surface water and their physical, chemical, and biological characteristics. Aquatic and wetland habitats and organisms are discussed under Section 3.14, Biological Resources. This section focuses on the potential effects of EELV development and operation on the physical and chemical factors that influence water quality and surface runoff. Effects from erosion are discussed in Section 3.8, Geology and Soils.

The federal Clean Water Act (CWA) is the primary law regulating water pollution. The CWA, as amended (P.L. 92-500), is administered by the U.S. EPA, which delegates authority to the appropriate state agency. The CWA defines the primary and secondary standards for water quality. Treated water discharged to surface water or to the ocean is subject to the requirements of a National Pollution Discharge Elimination System (NPDES) permit, which ensures that the water discharged meets water quality standards at the point of discharge. In addition, projects disturbing 5 acres or more are subject to NPDES permit requirements for storm water discharges during construction. This permit requires the preparation of a Storm Water Pollution Prevention Plan. Section 319 of the CWA requires states to assess nonpoint water pollution problems and to develop nonpoint source pollution management programs with controls to improve water quality. Section 404 of the CWA

requires a permit from the USACE in order to locate a structure, excavate, or discharge dredged or fill material into Waters of the United States.

Executive Order (EO) 11988, Floodplain Management, directs federal agencies to avoid to the extent possible the long- and short-term adverse impacts associated with occupancy and modification of floodplains. AFI 32-7064 (Chapter 4, Floodplain Management and Wetlands Protection) requires the Air Force to prepare a Finding of No Practicable Alternatives (FONPA) before construction within a floodplain. The Deputy Assistant Secretary (Environment, Safety, and Environmental Health) must approve the FONPA before initiation of construction activities.

3.9.1 Cape Canaveral AS

The ROI for groundwater includes the local aquifers that are directly or indirectly used by Cape Canaveral AS. The ROI for surface water is the drainage system/watershed in which the station is located. The St. John's River Water Management District (SJRWMD) issues the Environmental Resource Permit, which includes storm water and wetlands management, in coordination with the FDEP and the USACE. The FDEP is responsible for management of the NPDES permit process and wastewater discharges.

3.9.1.1 Groundwater. Two aquifer systems underlie Cape Canaveral AS: the surficial and the Floridan aquifer systems. The surficial aquifer system, which comprises generally sand and marl, is under unconfined conditions and is approximately 70 feet thick. The water table in the aquifer is generally a few feet below the ground surface. Recharge to the surficial aquifer is principally by percolation of rainfall and runoff. Groundwater in the surficial aquifer at Cape Canaveral AS generally flows to the west, except along the extreme eastern coast of the peninsula.

A confining unit composed of clays, sands, and limestone separates the surface aquifer from the underlying Floridan aquifer. The confining unit is generally 80 to 120 feet thick. The relatively low hydraulic conductivity of the confining unit restricts the vertical exchange of water between the surface aquifer and the underlying confined Floridan aquifer.

The Floridan aquifer is the primary source of potable water in central Florida and is composed of several carbonate units with highly permeable zones. The top of the first carbonate unit occurs at a depth of approximately 180 feet below ground surface, and the carbonate units extend to a depth of several hundred feet. Groundwater in the Floridan aquifer at Cape Canaveral AS is highly mineralized.

Cape Canaveral AS receives its potable water from the city of Cocoa, which pumps water from the Floridan aquifer. According to the General Plan, this water supply is more than adequate to meet usage demands and water quality standards (45 Space Wing, 1995).

3.9.1.2 Surface Water. Cape Canaveral AS is situated on a barrier island that separates the Banana River from the Atlantic Ocean. The station is within the Florida Middle East Coast Basin. This basin contains three major bodies of water in proximity to the station: the Banana River to the immediate west, Mosquito Lagoon to the north, and the Indian River to the west, separated from the Banana River by Merritt Island. All three water bodies are estuarine lagoons, with circulation provided mainly by wind-induced currents.

Surface drainage at Cape Canaveral AS generally flows to the west into the Banana River, even near the eastern side of the peninsula.

Several water bodies in the Middle East Coast Basin have been designated as Outstanding Florida Water (OFW) in FAC 62-3, including most of Mosquito Lagoon and the Banana River, Indian River Aquatic Preserve, Banana River State Aquatic Preserve, Pelican Island National Wildlife Refuge, and Canaveral National Seashore. These water bodies are afforded the highest level of protection, and any compromise of ambient water quality is prohibited. The Indian River Lagoon System has also been designated an Estuary of National Significance by the U.S. EPA. Estuaries of National Significance are identified to balance conflicting uses of the nation's estuaries while restoring or maintaining their natural character. The Banana River has been designated a Class III surface water, as described by the CWA. Class III standards are intended to maintain a level of water quality suitable for recreation and the production of fish and wildlife communities. There are no wild and scenic rivers located on or near Cape Canaveral AS.

Floodplains are lowland and relatively flat areas adjoining inland and coastal waters that are subject to flooding. The 100-year floodplain is subject to a 1-percent or greater chance of flooding in any given year. On Cape Canaveral AS, the 100-year floodplain extends 7 feet above MSL on the Atlantic Ocean side, and 4 feet above MSL on the Banana River side.

Concept A ROI. A portion of the area for construction of the assembly facilities south of SLC-41 at Cape Canaveral AS is within a 100-year floodplain.

Concept B ROI. There are no 100-year floodplains within areas proposed for EELV activities under Concept B.

3.9.1.3 Water Quality. Surface water quality near Cape Canaveral AS and KSC is monitored at 11 long-term monitoring stations that are maintained by NASA. The FDEP has classified water quality in the Florida Middle East Coast Basin as "poor to good" based on the physical and chemical characteristics of the water, as well as whether they meet their designated use under FAC 62-3. The upper reaches of the Banana River adjacent to Cape Canaveral AS and the lower reaches of Mosquito Lagoon have generally good water quality due to lack of urban and industrial development in the area. However, recent studies by NASA indicate that certain parameters (i.e., primarily phenols and silver) consistently exceed state water quality criteria, with hydrogen ion concentration (pH), iron, and aluminum occasionally exceeding criteria. Nutrients and metals, when detected, have generally been below Class II standards (National Aeronautics and Space Administration, 1995c). Areas of poor water quality exist along the western

portions of the Indian River, near the city of Titusville, and in Newfound Harbor in southern Merritt Island. Fair and poor water quality areas are influenced primarily by WWTP effluent discharges and urban runoff.

3.9.2 Vandenberg AFB

The ROI for groundwater includes the local aquifers that are directly or indirectly used by Vandenberg AFB. The ROI for surface water is the drainage system/watershed in which the base is located. In California, the state Water Resources Control Board and the Regional Water Quality Control Board (RWQCB) administer the CWA and state water regulations. The Central Coast Region RWQCB is the local agency responsible for the Vandenberg AFB area. The RWQCB is responsible for management of the NPDES permit process for California.

The California Porter-Cologne Water Quality Act provides a framework for establishing beneficial uses of water resources and the development of local water quality objectives to protect these beneficial uses. State regulations require a Waste Discharge Requirement (WDR) for permitting discharge. A Report of Waste Discharge (RWD) (similar to an NPDES permit application) is required for actions that will involve discharge of waste to surface and/or groundwater. The California Porter-Cologne Water Quality Act implements the NPDES program for the state.

3.9.2.1 Groundwater. The main sources of potable water in the region are from the San Antonio Creek Valley groundwater basin, the Lompoc Plain groundwater basin, the Lompoc Upland groundwater basin, and the Lompoc Terrace groundwater basin. These groundwater basins are pumped for potable water for Vandenberg AFB and the surrounding communities. Activities at Vandenberg AFB are concentrated in the Lompoc subarea (Lompoc Plain, Lompoc Upland, and Lompoc Terrace groundwater basins) and the western portion of the San Antonio Creek Valley basin.

Historically, the entire water supply on South Vandenberg AFB has been provided by two wells in the Lompoc Terrace Aquifer. These wells have been pumped at a rate that exceeds the natural recharge of the two wells. This sustained over-withdrawal has resulted in a 0.4-foot decrease in the aquifer each year over the last 10 years. Launch complex process water use represented nearly 17 percent of this overdraft condition.

3.9.2.2 Surface Water. Four major drainages occur on Vandenberg AFB: Cañada Tortuga Creek, Bear Creek, Cañada Honda Creek, and Jalama Creek. There are numerous unnamed minor drainage basins containing seasonal and ephemeral streams. Drainage from these basins is predominantly to the west, toward the Pacific Ocean.

The Santa Ynez River forms the geomorphic boundary between North and South Vandenberg AFB. The major drainage for South Vandenberg AFB is Cañada Honda Creek, with a watershed of about 12 square miles. Springs associated with Cañada Honda Fault usually issue a minimal flow of water to the watershed. There are no permanent lakes, impoundments, rivers, or floodplains on South Vandenberg AFB; however, there are several streams that drain directly into the ocean. Jalama Creek is near and outside the

southern boundary of the base. There are no 100-year floodplains within proposed EELV project locations.

Concept A ROI. In the vicinity of SLC-3W, the Lompoc Terrace is cut by Bear Canyon (southwest of SLC-3W) and Lompoc Canyon (east of SLC-3W). No perennial streams or springs exist on the SLC-3W site. Surface water from the site is directed toward Bear Creek Canyon.

Concept B ROI. No perennial streams or springs exist on the SLC-6 site. Erosion control ditches are used to direct surface water runoff created during storm events to a small arroyo on the north side of SLC-6. From this arroyo, the water flows toward the ocean and is either absorbed by the ocean or by soil before it reaches the ocean. Cañada Agua Viva is a south-flowing, perennial drainage located east of SLC-6 that is fed by two springs near Wild Horse Flats. Cañada Agua Viva has a watershed area of approximately 1 square mile.

3.9.2.3 Water Quality. Groundwater quality in the region meets all National Primary Drinking Water Regulation standards (U.S. Air Force, 1989a). Continued overdraft of the groundwater basins could lead to a degradation in the water table levels and a compaction of the basins. A slight decrease in water quality has been occurring in the region due to the use of water for irrigation. As this water flows through the soil back to the basin, it entrains salts and leads to a buildup of salts in the groundwater (U.S. Air Force, 1989a).

Groundwater monitoring is conducted for basins that are utilized for drinking water. Water in the San Antonio Valley Creek groundwater basin currently exceeds drinking water standards for total dissolved solids (TDS), manganese, and iron. The Lompoc Terrace groundwater contains constituents that exceed maximum contaminant levels (MCLs) for TDS. Groundwater is treated prior to its usage as potable water.

Watersheds are subject to on-base construction and agricultural runoff. San Antonio Creek, Santa Ynez River, and Shuman Canyon Creek also receive off-base agricultural runoff resulting in elevated dissolved solids, phosphates, and nitrates. Surface water is not directly used as a potable water supply at Vandenberg AFB. Ambient water quality sampling is performed by the Air Force.

3.10 AIR QUALITY (LOWER ATMOSPHERE)

This section describes air quality resources for the atmosphere at altitudes below 3,000 feet.

3.10.1 Federal Regulatory Framework

Air quality for both installations is regulated federally under Title 40 CFR 50 (National Ambient Air Quality Standards [NAAQS]), Title 40 CFR 51 (Implementation Plans), Title 40 CFR 61 and 63 (National Emission Standards for Hazardous Air Pollutants [NESHAPs]), and Title 40 CFR 70 (Operating Permits).

Title 40 CFR 50 (NAAQS). This regulation contains the NAAQS for primary and secondary criteria pollutants. The National Primary Ambient Air Quality Standards define the levels of air quality that the U.S. EPA judges as necessary to protect the public health with an adequate margin of safety. The National Secondary Ambient Air Quality Standards define levels of air quality that the U.S. EPA has determined to be necessary to protect the public welfare from any known anticipated adverse effects of a pollutant. There are standards for ozone (O_3), carbon monoxide (CO), NO_2, sulfur dioxide (SO_2), particulate matter equal to or less than 10 microns in diameter (PM_{10}), and lead (Pb).

Air quality in a given location is described as the concentration of various pollutants in the atmosphere, generally expressed in units of ppm or micrograms per cubic meter ($\mu g/m^3$), or in a pollution standard index. Air quality is determined by the type and amount of pollutants emitted into the atmosphere, the size and topography of the air basin, and the prevailing meteorological conditions. The significance of a pollutant concentration is determined by comparing it to federal and state ambient air quality standards.

According to U.S. EPA guidelines, an area with air quality better than the NAAQS is designated as being in attainment; areas with worse air quality are classified as nonattainment areas. A nonattainment designation is given to a region if the primary NAAQS for any criteria pollutant is exceeded at any point in the region for more than three days during a 3-year period. Pollutants in an area may be designated as unclassified when there is insufficient data for the U.S. EPA to determine attainment status.

The U.S. EPA is in the process of revising the NAAQS. New standards for ozone and particulate matter were published in the Federal Register on July 18, 1997. The new particulate standards are for particles less than 2.5 microns in diameter ($PM_{2.5}$). The standards are: an annual $PM_{2.5}$ standard of 15 micrograms per cubic meter ($\mu g/m^3$) based on a 3-year average of the arithmetic mean from community-oriented monitors (two monitors per urban area); a 24-hour standard set at 65 $\mu g/m^3$ based on the 3-year average of the 98^{th} percentile at each population-oriented monitor (one monitor per 1 million people) within an area; and a 24-hour PM_{10} standard based on the 99^{th} percentile of the 24-hour PM_{10} concentrations at each monitor within an area. The new ozone standard is 0.08 ppm, or 158 $\mu g/m^3$, based on the 3-year average of the fourth highest 8-hour average. Additionally, the 1-hour

standard (0.12 ppm, or 235 μg/m^3) remains in effect until the area is in attainment.

As the new standards are implemented, areas will be reclassified based on their attainment of the new criteria. The U.S. EPA plans to set up 1,500 new monitors to collect $PM_{2.5}$ data that will result in reclassifications between 2002 and 2004. There is already sufficient data to designate areas for the new ozone standard. However, the Presidential Memorandum publishing the new standards states that the Clean Air Act (CAA) provides up to 3 years for state governors to designate an area according to their most recent air quality and up to 3 additional years to develop and implement a State Implementation Plan (SIP) to provide attainment of the new standard.

The main criteria pollutants considered in this EIS are ozone, CO, NO_2, SO_2, and PM_{10}. Airborne emissions of lead are not addressed in this EIS because there are no known lead emission sources in the regions or proposed for use in any of the EELV alternatives.

Ozone is a secondary pollutant formed in the atmosphere by photochemical reactions of previously emitted pollutants, or precursors. Ozone precursors are mainly nitrogen oxides (NO_x) and VOCs. Volatile organic compounds (VOCs) are defined by the U.S. EPA as compounds containing carbon, excluding CO, carbon dioxide (CO_2), carbonic acid, metallic carbonates, ammonium carbonate, and organic compounds found not to contribute to ozone-generating reactions. NO_x is the designation given to the group of all oxygenated nitrogen species, including NO_2, nitrous oxide (N_2O), nitric oxide (NO), nitrogen trioxide (NO_3), N_2O_4, nitric anhydride (N_2O_5), and nitrous anhydride (N_2O_3). Although all of these compounds can exist in the air, only N_2O, NO, and NO_2 are found in appreciable quantities.

Nitrogen dioxide is primarily formed by the conversion of NO to NO_2 in the presence of oxygen (either during combustion or in the atmosphere). NO is produced by fuel combustion in both stationary and mobile sources, such as automobiles and aircraft. The amount of production is dependent upon the combustion temperature conditions and the rate of exhaust gas cooling. Higher temperatures and rapid cooling rates produce greater quantities of NO.

Carbon monoxide is formed through several processes, including incomplete fuel combustion. Sulfur dioxide is primarily formed through the combustion of sulfur-containing fuels, such as coal or oil. Particulate emissions are formed from several sources including fuel combustion, material processing, and road dust.

The states will consider activities that produce emissions at Cape Canaveral AS and Vandenberg AFB in developing their emission budgets and SIPs for achievement and maintenance of the NAAQS. The process by which emissions of these attainment pollutants is prevented from creating a nonattainment condition is called Prevention of Significant Deterioration (PSD). This process limits the allowable ambient impact of emissions from new major stationary sources or major modifications to specific increments designed to prevent any substantial degradation of the area's acceptable air quality. However, the PSD process currently applies only to ozone precursors

(VOC and NO_x), NO_2, SO_2, and particulate emissions (not CO), and does not provide a mechanism for dealing with non-stationary sources such as motor vehicles and aircraft.

Title 40 CFR 51 (Implementation Plans). This regulation contains the requirements pertaining to implementation plans, which are prepared by state or federal authorities with the goal of meeting the NAAQS.

Title 40 CFR 51 Part 93 (General Conformity). This regulation requires federal actions to conform to any SIP approved or promulgated under Section 110 of the CAA. A conformity determination is required for each pollutant resulting from a federal action for which the total of direct and indirect emissions in a nonattainment or maintenance area would equal or exceed de minimis thresholds listed in Title 40 CFR 51.853. The requirements for conformity determinations are detailed in Subpart W. The Air Force has developed an Air Force Air Conformity Guide recommended for use when preparing a conformity applicability analysis and/or Conformity Determination.

Title 40 CFR 61 and 63 (NESHAPs). The NESHAPs regulate stationary sources that were constructed or modified after the date of the publication of the regulations. These regulations require a written application for determination by the U.S. EPA of whether the stationary sources meet the regulation requirements. There is a variety of stationary sources specifically identified in the NESHAPs regulations; the standards for these sources are referred to as Maximum Available Control Technology (MACT) standards.

The NESHAPs regulations apply to specific types and sizes of equipment. The only section of the NESHAPs regulations that could apply to this analysis is Title 40 CFR 63 Subpart GG, which applies to facilities that manufacture or rework commercial, civil, or military aerospace vehicles or components and that are major sources of hazardous air pollutants (HAPs). These include cleaning operations, primer and topcoat application operations, depainting operations, chemical milling maskant application operations, and waste storage and handling operations.

Exemptions to this subpart include hazardous wastes that are subject to requirements of RCRA including specialty coatings, adhesives, adhesive bonding primers, or sealants at aerospace facilities; HAP or VOC contents less than 0.1 percent for carcinogens or 1.0 percent for noncarcinogens; and low-volume coatings.

This subpart gives the standards for cleaning operations, primer and topcoat application operations, depainting operations, chemical milling maskant application operations, and waste storage and handling operations. Also listed are the compliance dates and determinations, test methods and procedures, and monitoring, recordkeeping, and reporting requirements.

The owner or operator of an affected source is also subject to sections of Subpart A, including prohibited activities and circumvention (Section 63.4); construction and reconstruction (Section 63.5); and compliance with standards and maintenance requirements (Section 63.6). A startup, shutdown, and malfunction plan for an air pollution control device or equipment to control HAP emissions must be prepared and operated in accordance with Title 40 CFR 63.743(b).

Title 40 CFR 70 (Operating Permits). Title V of the Clean Air Act Amendments (CAAA) of 1990 requires all major sources to file an operating permit application. The operating permit incorporates all applicable federal requirements under the CAA affecting the respective sources. A major source is defined as a source that has the potential to (1) emit 100 tons per year of any regulated air pollutant within an area that is in attainment for that pollutant; (2) emit 10 tons per year of any one of the 189 HAPs; or (3) emit 25 tons per year of total HAPs. If the source is in a nonattainment area for a pollutant, the major source thresholds can be lower. For example, if the source is in a zone designated as a "serious" nonattainment area for ozone, the major source threshold for ozone precursors (NO_x and VOCs) is 50 tons per year rather than 100 tons per year.

On August 2, 1996, the U.S. EPA issued the memorandum *Major Source Determinations for Military Installations under the Air Toxics, New Source Review, and Title V Operating Permit Programs of the Clean Air Act.* This memorandum recommends procedures to divide military installations into sections when determining whether Title V and other air programs apply. For example, activities under the control of different military services can be considered to be in separate facilities.

Because potential emissions are above major source thresholds, Cape Canaveral AS is currently a major source with respect to Title 40 CFR 70 regulations. The Title V Operating Permit application has been submitted to the FDEP and is under review. This application treats Cape Canaveral AS as a single major facility. The station can continue operations until the review is complete.

Vandenberg AFB has entered into an agreement with the U.S. EPA as part of the Environmental Investment (ENVVEST) program. This program is designed to allow operational flexibility in reducing emissions and complying with environmental regulations. The program is the result of a November 1995 Memorandum of Agreement between DoD and the U.S. EPA on Regulatory Reinvention Pilot Projects (Project XL). On September 8, 1997, the proposed Project XL Final Project Agreement for Vandenberg AFB was published in the Federal Register.

As part of the ENVVEST program, Vandenberg AFB is being exempted from the requirements of Title 40 CFR 70. Instead, Vandenberg AFB has facility-specific operational and reporting requirements. Vandenberg AFB has committed to implementing "a phased program to reduce annual emissions of ozone precursors by at least 10 tons by November 30, 2002." This is expected to be accomplished through the reduction of emissions from boilers, furnaces, and process heaters.

Vandenberg AFB has prepared a final draft Major Source Determination, which reviewed the stationary source air emissions and used the EPA's Major Source Guidance for military installations to determine where the emissions were coming from and under whose control (Standard Industrial Classification [SIC] Code) the emissions fall. Following the inventory and assessment, the Santa Barbara County Air Pollution Control District (SBCAPCD) and Vandenberg AFB determined that the base would be divided into separate source designations and the SBCACPD would implement a new rule capturing this decision. This rule, Rule 1301, was issued September 18, 1997. Currently, the stationary source designations are: Air Force Primary Mission, Remediation, NASA, Flight Line, Navy, Range Group, Amenities Group, Hospital Services, and Commercial Space.

Title 40 CFR 82 (Protection of Stratospheric Ozone). This regulation seeks to prevent damage to the ozone layer by Class I and Class II Ozone-Depleting Substances (ODSs) and contains subparts addressing production and consumption controls, servicing of motor vehicle air conditioners, bans on nonessential products, federal procurement, recycling and emissions reduction, and alternative compounds. The regulations relating to federal procurement state that safe alternatives to Class I and Class II ODSs shall be substituted to the maximum extent practicable. The regulations additionally require contractors to ensure compliance with Title 40 CFR 82 regulations, proper labeling, and reporting of the use of ODSs.

3.10.2 Cape Canaveral AS

3.10.2.1 Florida Regulatory Framework. Air quality for the Cape Canaveral AS area is regulated under FAC 62-200 et seq. Specific regulations that may be applicable to EELV activities include FAC 62-204.240 (Ambient Air Quality Standards), FAC 62-210 (Stationary Source General Requirements), FAC 62-212 (Stationary Source Preconstruction Permitting), FAC 62-213 (Operating Permits), and FAC 62-242 (Mobile Sources).

FAC 62-204.240 (Ambient Air Quality Standards). This rule lists the ambient air quality standards for Florida (Table 3.10-1). The Florida Ambient Air Quality Standards (FAAQS) are not significantly different from the NAAQS.

FAC 62-210 (Stationary Source General Requirements). This rule establishes general requirements for stationary sources of air pollutant emissions and provides criteria for determining the need to obtain an air construction or air operation permit. It establishes public notice and reporting requirements and

Table 3.10-1. National and Florida Ambient Air Quality Standards

Pollutant	Averaging Time	Florida Standards[a, b] ($\mu g/m^3$)	National Standards ($\mu g/m^3$) [c]	
			Primary [d]	Secondary [e]
Ozone	1 Hour	235	235	235
Carbon Monoxide	8 Hours	10,000	10,000	----
	1 Hour	40,000	40,000	----
Nitrogen Dioxide	Annual	100	100 [f]	Same as primary standard
Sulfur Dioxide	Annual	60	80	----
	24 Hours	260	365	----
	3 Hours	1,300	----	1,300
PM_{10}	Annual	50	50 [f]	Same as primary standard
	24 Hours	150	150	Same as primary standard
Lead	Quarterly	1.5	1.5	Same as primary standard

Notes: (a) Florida standards for ozone, carbon monoxide, sulfur dioxide, nitrogen dioxide and PM_{10} are values that are not to be exceeded. The lead value is not to be equaled or exceeded.

(b) Values for standards are based on a reference temperature of 25 degrees Celsius (°C) and a reference pressure of 760 millimeters (mm) of mercury. All measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 mm of mercury (1,013.2 millibars).

(c) National standards other than ozone and those based on annual averages or annual arithmetic means are not to be exceeded more than once a year. The ozone standard is attained when the expected number of days per calendar year, with maximum hourly average concentrations above the standards, is equal to or less than one. The lead and annual sulfur dioxide standards are not to be exceeded in a calendar year.

(d) National Primary Standards: The levels of air quality necessary to provide an adequate margin of safety to ensure protection of the public health.

(e) National Secondary Standards: The levels of air quality necessary to provide that the public welfare is safe from any known or anticipated adverse effects of pollutant.

(f) Calculated as arithmetic mean.

$\mu g/m^3$ = micrograms per cubic meter
PM_{10} = particulate matter equal to or less than 10 microns in diameter

Source: Title 40 Code of Federal Regulations 50 and Florida Administrative Code 62-204.240

requirements relating to estimating emission rates and using air quality models. This chapter also sets forth special provisions related to compliance monitoring, stack heights, circumvention of pollution control equipment, and excess emissions.

FAC 62-212 (Stationary Source Preconstruction Permitting). The preconstruction review requirements for proposed new emissions units or facilities and proposed modifications are established in this rule. The requirements of this chapter apply to those proposed activities for which an air construction permit is required. This chapter includes general preconstruction review requirements and specific requirements for emissions units subject to PSD and nonattainment area preconstruction review. It also includes preconstruction review requirements applicable to specific emissions unit types.

FAC 62-213 (Operating Permits). This rule implements federal rule Title 40 CFR 70, which provides a comprehensive operation permit system for permitting major sources of air pollution (Title V sources). The amount and schedule of payment of the annual emissions fee are provided. For facilities

operating under the terms of Title V air general permits, applicability, general procedures and conditions, and local air program requirements are explained. Also provided are permit requirements for all Title V sources, changes allowed at a source without necessitating a permit revision, allowable trading of emissions within a source, permit application compliance, permit issuance, renewal and revision, and permit review by the U.S. EPA and any affected states.

Because potential emissions are above major source thresholds, Cape Canaveral AS is currently a major source with respect to FAC 62-213 regulations. The Title V Operating Permit application has been submitted to the FDEP and is under review.

3.10.2.2 Meteorology. Cape Canaveral AS is on the northern portion of a barrier island on the Atlantic Ocean, situated midway up the Florida peninsula (28.5°N latitude). The climate at Cape Canaveral AS is best characterized as maritime-tropical with long, relatively humid summers and mild winters. This barrier island experiences moderate seasonal and daily temperature variations. Average annual temperature is 71°F with a minimum monthly average of 60°F in January and a maximum of 81°F in July. During the summer, the average daily humidity range is 70 to 90 percent. The winter is drier with humidity ranges of 55 to 65 percent; frosts are quite rare. Despite average drier conditions during the winter, most occurrences of fog (54 days of the year) occur during the winter and are associated with the passage of weather fronts.

The seasonal wind pattern is reflected in the speed and direction statistics presented in Table 3.10-2. During the winter, the prevailing winds steered by the jet stream aloft are frequently from the north and west, and the land-sea temperature diminishes, resulting in fewer easterly sea breezes that counter the prevailing westerly winds. As the jet stream retreats northward during the spring, the prevailing winds shift and come out of the south. During the summer and early fall, as the land-sea temperature difference increases and the Bermuda high-pressure region strengthens, the winds originate predominantly from the south and east.

Under normal midday weather conditions, surface mixing occurs over a layer with an average daily maximum value of 2,300 to 2,950 feet during the winter and 3,900 to 4,600 feet during the summer. The mixed layer is rarely capped by a strong temperature inversion. At the surface, easterly sea breezes with moderate speeds (5 to 10 miles per hour [mph]) and depths on the order of 500 to 1,000 feet occur nearly every day during the summer and early fall. Aloft, the prevailing winds are more westerly and northerly during the winter due to the southward migration of the jet stream.

Table 3.10-2. Climatological Data, Kennedy Space Center

Month	Surface Winds: Prevailing Direction	Surface Winds: Mean Speed (mph)	Mean Number of Days Occurrence: Precipitation (inches) [a] $0.01	Precipitation (inches) [a] $0.5	Thunder-storms	Fog Visibility <2 miles
January	NNW	8	7	2	1	9
February	N	8	7	2	2	7
March	SSE	8	8	2	3	7
April	E	9	5	1	3	4
May	E	8	8	2	8	3
June	E	7	12	3	13	2
July	S	6	11	4	16	2
August	E	6	11	3	14	2
September	E	6	13	4	10	2
October	E	8	11	3	4	3
November	N	7	7	2	1	6
December	NW	8	8	1	1	7
Annual	E	7	108	29	76	54
Years of Record	10	10	26	26	26	26

Note: (a) Snowfall has not occurred in 26 years.
E = east
mph = miles per hour
N = north
NNW = north northwest
NW = northwest
S = south
SSE = south southeast

Source: U.S. Air Force, 1991e

Most periods of high winds and heavy rainfall occur during thunderstorms, which develop mainly from May through September (see Table 3.10-2). The Cape Canaveral AS region has the highest number of thunderstorms in the world during the summer months. On the average, there are thunderstorms on 76 out of 180 days. Over 70 percent of the annual 48 inches of rain occurs during the summer. During thunderstorms, wind gusts of more than 60 mph and rainfall of over 1 inch often occur in a one-hour period. Numerous lightning strikes to the ground occur (1,400 strikes per month over the 135-square-mile region surrounding Cape Canaveral). During such weather, flight activities at Cape Canaveral AS are often suspended. Hurricanes can also occur, normally between August and October. Landfall for hurricanes is relatively infrequent. Flight activities are suspended during hurricanes.

3.10.2.3 Regional Air Quality. Existing air quality is defined by air quality data and emissions information. Air quality data are obtained by examining records from air quality monitoring stations maintained by the FDEP. Information on pollutant concentrations measured for short-term (24 hours or less) and long-term (annual) averaging periods is extracted from the monitoring station data in order to characterize the existing air quality background of the area.

The FDEP classifies areas of the state that are in attainment or nonattainment of the FAAQS. In Florida, regional air quality is assessed at the county level. Cape Canaveral AS is in Brevard County (Figure 3.10-1),

which has been designated by both the U.S. EPA and the FDEP to be in attainment for ozone SO_2, NO_x, CO, and PM_{10}. As discussed in Section 3.10.1, the NAAQS are being revised; these revisions may affect the attainment status of Brevard County.

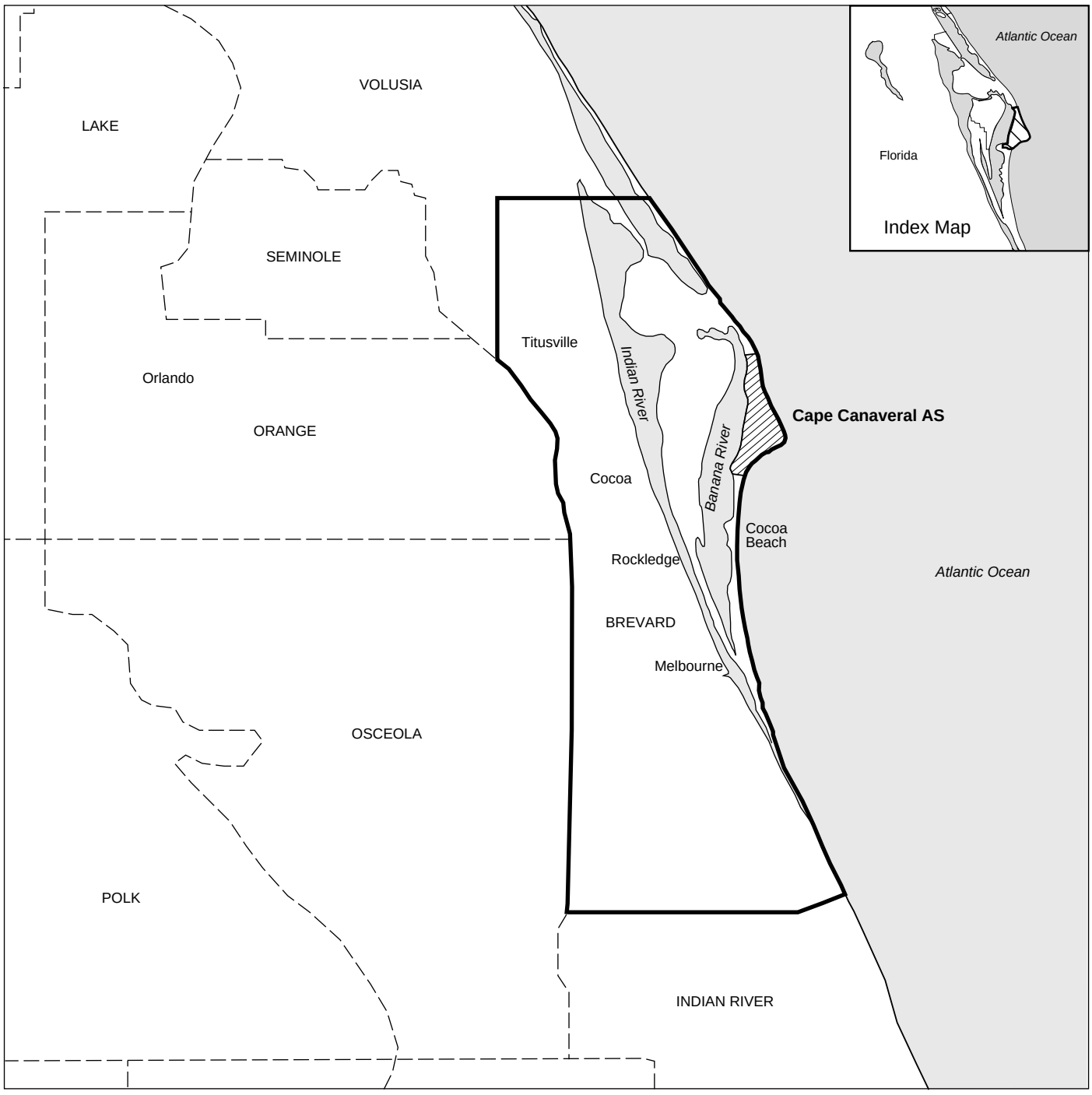
The ROI for lower-atmosphere air quality resources may extend beyond the project boundaries (i.e., the launch complexes and other construction areas) to include those areas significantly affected by air dispersion and/or commuter traffic. This could include an area as large as the regional air quality basin (Brevard County) and may affect the maintenance of the NAAQS and the FAAQS for Brevard County.

Ambient air quality is measured at weather stations throughout Florida. The nearest weather station to Cape Canaveral AS, at the KSC, measures ozone NO_2, SO_2, PM_{10}, and CO. The nearest weather station that monitors lead level concentrations is the Orlando station in Orange County. Table 3.10-3 shows available 1995 hourly average ambient air concentrations for criteria pollutants.

Table 3.10-3. 1995 Average Ambient Air Concentrations for Criteria Pollutants Near Cape Canaveral AS

Pollutant	Averaging Time	Concentration ($\mu g/m^3$)
O_3	Hourly	57.4
NO_x	Hourly	11.4
	Yearly	1.4
SO_2	3 Hours	19.4
	24 Hours	5.8
PM_{10}	Hourly	15.0
Pb	Hourly	0.0
CO	Hourly	4,230
	8 Hours	2,640

CO = carbon monoxide
$\mu g/m^3$ = micrograms per cubic meter (approximate, converted from parts per million)
NO_x = nitrogen oxides
O_3 = ozone
Pb = lead
PM_{10} = particulate matter equal to or less than 10 microns in diameter
SO_2 = sulfur dioxide



EXPLANATION

Counties

Brevard County

Air Quality Region of Influence, Cape Canaveral AS

0 3.75 7.5 15 Miles

Figure 3.10-1

EELV/069

In addition to regional impacts, emissions from specific sources can impact local air quality. If a specific source emits high levels of a pollutant, it can significantly increase the concentration of that pollutant in the vicinity of the source. Sources of criteria pollutants and sources of HAPs can have local air quality impacts.

3.10.2.4 Air Emissions. Emission inventory information for the affected environment was obtained from the FDEP and from Cape Canaveral AS. Inventory data for each pollutant are reported in tons per year in order to describe the baseline conditions of pollutant emissions in the area.

In July 1996, an Air Emissions Inventory report was completed for Cape Canaveral AS for calendar year 1994 (Radian International, 1996). This report lists emissions from all stationary sources at Cape Canaveral AS (Table 3.10-4), as well as from other activities, such as the generation of road dust.

Table 3.10-4. Cape Canaveral AS Baseline Emissions[(a)]

	VOC	NO_x	CO	SO_2	PM_{10}
Existing Launch Program					
Vehicle Launches	0.0	13.3	0.0	0.0	144.1
Vehicle Preparation, Assembly, and Fueling	14.9	0.0	0.0	0.0	5.0
Mobile Sources	37.6	63.6	311.3	2.9	128.6
Point Sources	1.0	22.9	6.2	17.7	1.0
Total	53.6	99.8	317.5	20.6	278.6
Cape Canaveral AS 1994 Air Emissions Inventory Report[(b)]	104.4	382.9	274.5	102.6	75.5
Brevard County Point Source	107	11,514	991	26,492	340
Brevard County Area Source	24,876	14,608	13,3752	1,032	34,750
Brevard County Total	24,983	26,122	13,4743	27,524	35,090

Note: (a) All emissions in tons per year for 1995 unless otherwise indicated.
(b) Includes stationary source emissions only.
AS = Air Station
CO = carbon monoxide
NO_x = nitrogen oxides
PM_{10} = particulate matter equal to or less than 10 microns in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compound

A baseline launch emissions inventory has been generated for the applicable launch activities in 1995. The baseline emissions included in this inventory are specifically for the current launch vehicle systems (Atlas II, Delta II, and Titan IV), and associated support activities. This inventory includes estimates of emissions from the following key sources:

- Vehicle launch
- Vehicle preparation, assembly, and fueling
- Mobile sources such as support equipment, commercial transport vehicles (including trucks and aircraft), and personal vehicles
- Point sources such as heating/power plants, generators, incinerators, and storage tanks.

Estimates are divided into two categories: emissions that are directly launch-related and infrastructure emissions. Launch-related emissions are estimated on a pounds-per-launch basis. Infrastructure emissions are estimated on a pounds-per-day basis and are assumed to take place regardless of the number of launches per year. Emission comparisons are summarized in Table 3.10-4 for criteria pollutants. Emissions from each of the key sources are calculated as described below.

Vehicle Launch. Table 3.10-5 lists expendable vehicle launches from Cape Canaveral AS in 1995. Actual launch emissions are estimated using kinetics and flowfield models as described below. Emissions predicted to be below 3,000 feet in altitude are included in the inventory totals. Emissions at altitudes above 3,000 feet are addressed in Section 3.11, Air Quality (Upper Atmosphere). Emissions are addressed only for those vehicles that would be replaced by EELV launches (Atlas II, Delta II, Titan IV).

Table 3.10-5. 1995 Launches, Cape Canaveral AS

Date	Vehicle	Launch Complex
January 10	Atlas IIAS	SLC-36B
January 28	Atlas IIA	SLC-36A
March 22	Atlas IIAS	SLC-36B
April 8	Atlas IIA	SLC-36
May 14	Titan IV	SLC-40
May 23	Atlas I	SLC-36B
May 31	Atlas IIA	SLC-36A
July 10	Titan IV	SLC-41
July 31	Atlas II	SLC-36A
August 5	Delta II	SLC-17
August 28	Atlas IIAS	SLC-36B
October 22	Atlas II	SLC-36A
November 6	Titan IV	SLC-40
December 2	Atlas IIAS	SLC-36B
December 15	Atlas IIA	SLC-36A
December 30	Delta II	SLC-17A

SLC = Space Launch Complex

A standard Two-Dimensional Kinetics (TDK) Nozzle Performance Computer Model (version 1993) models the engine performance to provide information on the mass flux out of the engine. The Standardized Plume Flowfield Model (SPF-3) is used to model after-burning to provide mass fractions of chemical products such as NO_x, carbon, and chlorine compounds found in some fuels as a function of atmospheric density and temperature.

Emission estimates were made using the launch trajectory information for LEO and geosynchronous orbit missions. The fraction of each propellant emitted below 3,000 feet, along with the height-dependent mass fractions from SPF-3, are used to estimate the emissions. Information on mission trajectory for each launch in Table 3.10-5 was not available, so an equal split between the two trajectories was assumed for each launch vehicle.

The emissions shown in Table 3.10-4 are totals for emissions from the selected 1995 launch vehicles. These data are useful for estimating the effect of these launches on regional air quality. In addition, the launches can impact local air quality by causing a short-term increase in pollutant concentrations near the launch site. These impacts are best addressed on a per-launch basis for each vehicle type. The relevant comparisons are presented in the analysis within Section 4.10.

Vehicle Preparation, Assembly, and Fueling. For the 15 launches included in the 1995 baseline, most of the preparation and assembly operations took place at Cape Canaveral AS. However, the majority of these activities do not produce air emissions. Emissions are estimated for solvent cleaning and sanding activities, which produce VOC and particulate emissions, respectively. Payload processing is not included in the vehicle preparation emissions estimates, as it is considered separate from the vehicle preparation activities.

For years prior to the baseline emissions year (1995), the rocket engines for each vehicle were sometimes flushed with chlorinated solvent (notably TCE). By 1995, efforts to replace the use of chlorinated solvents had progressed to the point where little or no chlorinated solvent was used for rocket engine cleaning.

ODSs are used for refrigeration, fire suppression, and some degreasing operations. Some emissions can occur from leakage from refrigeration and fire suppression systems as well as from evaporation during cleaning and degreasing. Total ODS emissions associated with the Atlas, Delta, and Titan operations are estimated to be 192 pounds for 1995 Cape Canaveral AS operations.

Fueling of hydrogen involves some venting of hydrogen through a flare. Each flare uses propane as auxiliary fuel. Emissions of combustion products from the hydrogen control flares are estimated using EPA AP-42 standard factors for external combustion; these emissions are very minor.
Emissions from RP-1 storage and fueling are estimated using U.S. EPA AP-42 emission factors. Estimates are made for working emissions, caused by filling and emptying the storage tanks, and breathing emissions, caused by daily warming and cooling of the tanks in the sunlight. Because RP-1 is not a very volatile fuel, emissions from RP-1 storage tanks are very small.

Emissions from hydrazine and N_2O_4 loading are controlled by a combination of sealed transfer systems, wet scrubbing, and oxidation. Emissions of hydrazine are listed as HAP emissions, discussed below. Emissions of N_2O_4 (a form of NO_x) are insignificant compared to other sources of nitrogen oxides.

After vehicle launch, the SLC must be cleaned and repaired. Surfaces are cleaned using an abrasive blaster; ablative coatings are applied, and painted surfaces are touched up or repainted. Particulate emissions from sandblasting are estimated based on estimated use and a particulate emission factor. VOC emissions from coatings are obtained from coating use quantity estimates.

Mobile Sources. Mobile emission sources include:

- Vehicle Deliveries and Miscellaneous Supply Traffic
- Vehicle Assembly and On-Site Transport
- Personal Automobile Use.

Vehicle Deliveries and Miscellaneous Supply Traffic

The Atlas, Delta, and Titan vehicle components were delivered by truck and airplane. Truck emissions are calculated using pounds of emissions per Vehicle Miles Traveled (VMT) for both on- and off-site trips. Emission factors are taken from the MOBILE 5a and PART5 computer models. Emissions from required escort cars for oversize loads are calculated similarly.

Because the ROI for Cape Canaveral AS includes all of Brevard County, transportation emissions are calculated for all vehicular traffic directly related to EELV activities that take place in Brevard County.

Deliveries made by truck are assumed to involve round-trip traffic to and from the northern county line (50 percent) or the southern county line (50 percent). It is assumed that travel would occur along Interstate 95 occurs.

Portions of the Atlas, Delta, and Titan vehicles are delivered by airplane. The Delta deliveries are made using a C-141 aircraft. Emissions from the C-141 aircraft associated with landing and take-off are calculated using the factors available in the computer model Emissions and Dispersion Modeling System (EDMS), Version 3.0. The Titan deliveries are made using a C-5 Galaxy aircraft. Emissions from the C-5 aircraft associated with landing and take-off and emissions of particulate matter are calculated using the factors available in the Calculation Methods for Criteria Air Pollutant Emission Inventories (Jagielski and O'Brien, 1994).

Vehicle Assembly and On-Site Transport

Assembly of vehicle components and on-site transport of the vehicle create emissions from mobile sources, several of which are standard vehicles (trucks, etc.). Emissions from these sources are estimated using VMT and the emission factors available in the MOBILE 5a and PART5 computer models.

Other mobile sources (cranes, specialized transport vehicles) are not standard and therefore have no associated standard emission factors. Emissions from these vehicles are calculated using hours of operation, rated capacity (in horsepower), and the stationary source AP-42 emission factors for the appropriate engine types. Pollutant activities from these sources are relatively minor, and general estimates are used where specific data are not available.

Personal Automobile Use

Emissions from employee personal automobile use are calculated based on both on- and off-site emissions. Based on studies conducted for this EIS, employees' places of residence were identified and commuting distances calculated from the center of their resident cities to Cape Canaveral AS. Non-work trip VMT are also included in the total off-site VMT. The average vehicle ridership number is applied to VMT calculations. Emissions are calculated using VMT and the emission factors available in the MOBILE 5a and PART5 computer models. A surge in automobile traffic prior to launch, associated with pre-launch processing activities, is accounted for in the calculations.

Point Sources. Point sources include combustion sources, such as boilers and internal combustion engines. Emissions from other point sources such as spray booths and solvent cleaning equipment are included in the total emission calculations for vehicle preparation and assembly. Emissions from boilers and internal combustion engines are listed in the July 1996 Air Emissions Inventory report for Cape Canaveral AS (Radian International, 1996). The emissions from these sources are attributed to the Atlas, Delta, and Titan programs for use in this baseline emissions inventory.

Hazardous Air Pollutants. Emissions of HAPs have been quantified from emission sources addressed in the criteria pollutant section of this analysis. In quantifying emissions, HAP emissions can occur from three separate activities:

- Vehicle Launch (chlorine compounds)
- Fuel Loading (hydrazine)
- VOC solvent and coating usage (VOC HAPs such as toluene and methyl ethyl ketone).

Emissions of chemically active chlorine compounds (Cl_x) from vehicle launch are estimated using the TDK and SPF-3 models. These emissions include hydrochloric acid (HCl), chlorine (Cl), and other chemically active compounds; chemically inactive compounds such as aluminum chlorides are treated as particulate matter (PM). Hydrazine emissions from fuel loading are estimated based on an estimated percentage loss during fueling and an estimated control efficiency for the wet scrubber/oxidizer vapor control systems. Emissions of VOC HAPs from solvent and coating usage are conservatively assumed to be 100 percent of the VOC emissions from these sources. Baseline emissions of HAPs for Cape Canaveral AS are summarized in Table 3.10-6.

Table 3.10-6. Cape Canaveral AS Baseline HAPs Emissions[(a)]

	Cl_x	Hydrazine fuels	VOC HAP
Vehicle Launches	72.3	0.0	0.0
Vehicle Fueling	0.0	<0.01	<0.01
Vehicle Coating/Solvent Use	0.0	0.0	14.9
Project Total	72.3	<0.01	14.9

Note: (a) All emissions in tons per year for 1995
Cl_x = chlorine compounds
HAP = hazardous air pollutant
VOC = volatile organic compound

3.10.3 Vandenberg AFB

3.10.3.1 California Regulatory Framework. Air quality for the Vandenberg AFB area is regulated under the California Code of Regulations (CCR), Title 17, Division 3, Chapter 1. Specific regulations of interest include CCR 17-Section 70200 (Ambient Air Quality Standards), and CCR 17-Section 93000 et seq. (Toxic Air Contaminants). Vandenberg AFB is also regulated by the SBCAPCD. Specific regulations of interest include Regulation II (Permits), Regulation X (NESHAPs), and Regulation XIII (Operating Permits).

CCR 17-Section 70200. California Ambient Air Quality Standards (CAAQS). The California Air Resources Board (CARB) has developed ambient air quality standards (Table 3.10-7), which represent the maximum allowable atmospheric concentrations that may occur and still ensure protection to public health and welfare with a reasonable margin of safety.

Table 3.10-7. National and California Ambient Air Quality Standards

Pollutant	Averaging Time	California Standards[a,c] (µg/m^3)	National Standards (µg/m^3)[b]	
			Primary[d]	Secondary[e]
Ozone	1 Hour	180	235	Same as primary standard
Carbon Monoxide	8 Hours	10,000	10,000	----
Nitrogen Dioxide	1 Hour	23,000	40,000	Same as primary standard
	Annual	----	100 [g]	
Sulfur Dioxide	1 Hour	470		----
	Annual	----	80	----
	24 Hours	1050	365	----
	3 Hours	----	----	0.5 ppm (1,300 µg/m^3)
PM_{10}	1 Hour	655	----	----
	Annual	30 [f]	50 [g]	Same as primary standard
Sulfates	24 Hours	50	150	Same as primary standard
Lead	24 Hours	25	----	----
	30 Days	1.5	----	----
	Quarterly	----	1.5	Same as primary standard
Hydrogen Sulfide	1 Hour	42	----	----
Vinyl Chloride	24 Hours	26	----	----
Visibility-Reducing Particles[h]	8 Hours (10 a.m. to 6 p.m., Pacific Standard Time)	In a sufficient amount to produce an extinction coefficient of 0.23 per km due to particles when the relative humidity is less than 70 percent CARB Method V.		

Notes:
(a) California standards for ozone, carbon monoxide, sulfur dioxide (1 hour and 24 hours), nitrogen dioxide, particulate matter less than 10 microns in diameter (PM_{10}), and visibility-reducing particles are values that are not to be exceeded. The sulfates, lead, hydrogen sulfide, and vinyl chloride standards are not to be equaled or exceeded.
(b) National standards other than ozone and those based on annual averages or annual arithmetic means are not to be exceeded more than once a year. The ozone standard is attained when the expected number of days per calendar year, with maximum hourly average concentrations above the standards, is equal to or less than one.
(c) Values for standards are based on a reference temperature of 25 degrees Celsius (°C) and a reference pressure of 760 millimeters (mm) of mercury. All measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 mm of mercury (1,013.2 millibars).
(d) National Primary Standards: the levels of air quality necessary to provide an adequate margin of safety to ensure protection of the public health.
(e) National Secondary Standards: the levels of air quality necessary to provide that the public welfare is safe from any known or anticipated adverse effects of pollutant.
(f) Calculated as geometric mean.
(g) Calculated as arithmetic mean.
(h) This standard is intended to limit the frequency and severity of visibility impairment due to regional haze and is equivalent to a 10-mile nominal visual range when relative humidity is less than 70 percent.

CARB = California Air Resources Board
km = kilometer
µg/m^3 = micrograms per cubic meter
PM_{10} = particulate matter equal to or less than 10 microns in diameter
ppm = parts per million

Source: California Air Resources Board, 1992

CCR 17-93000 et seq. (Toxic Air Contaminants). Subchapter 7 of this regulation defines toxic air pollutants as well as HAPs (including hydrazine fuel). Subchapter 7.5 contains requirements for air toxics control measures; these requirements are industry-specific. Subchapter 7.6 (CCR 17-93300)

incorporates by reference Health and Safety Code sections 44300-44394 (Part 6), which codify the requirements of the Air Toxics "Hot Spots" Information and Assessment Act of 1987.

Changes to the use of toxic and hazardous air pollutants on site may require the submission of an Air Toxic "Hot Spots" Questionnaire. The SBCAPCD may require Vandenberg AFB to file or update its AB-2588 toxic plan. In addition, Part 6 Chapter 3 (Section 44340) of the Air Toxics "Hot Spots" Information and Assessment regulations requires preparation and submission of a comprehensive emissions inventory plan.

SBCAPCD Regulations, Regulation II - Permits. This regulation requires that any person building, erecting, altering, or replacing any article, machine, equipment, or other contrivance, the use of which may cause the issuance of air contaminants, or the use of which may eliminate or reduce or control the issuance of air contaminants, shall first obtain authorization for such construction from the Control Officer in the form of an Authority to Construct Permit. This permit shall remain in effect until the permit to operate the equipment for which a permit application was filed is granted or denied or the application is canceled. The facility must have a permit to operate before equipment may be operated or used; a written permit shall be obtained from the Control Officer. The application must include information or analysis that will disclose the nature, extent, quantity, or degree of air contaminants the source may discharge. An application may also be necessary for equipment that is modified.

In 1991, a Memorandum of Agreement (MOA) between the Air Force and the SBCAPCD designated Vandenberg AFB as a single stationary source. Under this MOA, new or modified sources would require Best Available Control Technology (BACT) and offsetting reduction of emissions elsewhere on base if emissions are increased at SLC-3W. Recent changes to the SBCAPCD regulations are affecting the regulatory framework for Vandenberg AFB, and the 1991 MOA may no longer be applicable.

Santa Barbara County Air Pollution Control District Regulation VII.702 (General Conformity). In October 1994, the SBCAPCD adopted Rule 702, taken verbatim from Subpart W, except for Section 51.860 (mitigation measures), in order to address General Conformity.

Santa Barbara County Air Pollution Control District Regulations Regulation X (National Emission Standards for Hazardous Air Pollutants). This regulation incorporates the federal regulation for NESHAPs (Title 40 CFR 61 and 63) and provisions recently promulgated by the U.S. EPA as published in the Federal Register.

SBCAPCD Regulation X incorporates the federal NESHAPs regulations, including 40 CFR 63 Subpart GG (National Emission Standards for Aerospace Manufacturing and Rework Facilities).

Santa Barbara County Air Pollution Control District Regulations, Regulation XIII (Operating Permits). This regulation incorporates the federal regulation for Operating Permits under Title 40 CFR Part 70, which states that federally enforceable requirements include, but are not limited to, New Source

Performance Standards (NSPS), PSD, New Source Review (NSR), NESHAPs, NAAQS, Maximum Available Control Technology (MACT) Standards, Title III Section 112, Title IV (Acid Deposition Control), and Title VI (Stratospheric Ozone Protection).

As discussed in Section 3.10.1, Vandenberg AFB has entered into an agreement with the U.S. EPA and SBCAPCD as part of the ENVVEST program. As part of this program, Vandenberg AFB has been exempted from the requirements of Title 40 CFR 70 and therefore from SBCAPCD Regulation XIII. Instead, Vandenberg AFB has facility-specific operational and reporting requirements.

3.10.3.2 Meteorology. Vandenberg AFB is situated on Point Arguello on the California coast in the western portion of Santa Barbara County. The climate is categorized as Mediterranean, or dry and subtropical. The coastal location of Vandenberg AFB experiences moderate seasonal and diurnal variation in temperature and humidity. Temperatures are mild, ranging from 45 degrees (°) Fahrenheit (F) to 85°F with an annual mean temperature of 55°F. Temperatures below freezing and above 100°F are rare. The rainy season extends from November to April. Annual precipitation is 13 inches with the most rain falling during February (2.6 inches) and the least during July (0.01 inch). The annual relative humidity is 77 percent. The driest periods occur during the fall, when Santa Ana winds can result in humidity as low as 10 percent.

The Point Arguello region consists of moderately complex terrain consisting of steep hills and valleys. Because of its terrain and the fact that it is bounded by the ocean on two sides, there is a geographically variable wind field at the surface. The mean annual wind speed in the area is 7 mph out of the northwest. The strongest winds occur during the winter and midday, and at ridge lines. Over half the time, the wind blows at speeds greater than 7 mph at the base. Calms are rare (less than 1 percent), and the lowest wind speeds occur during the evening and early morning hours. Easterly winds occur very infrequently and generally occur during the fall, when Santa Ana winds may invade the region for a day or two.

The diurnal weather pattern in the area is characterized by nighttime and early-morning low cloud cover and coastal fog. Cloud cover occurs almost half of the time. The fog burns off by mid-morning and is replaced by a sea breeze as the land begins to warm. Sea breezes are less frequent during the winter. The average visibility is the worst during July through September due to the occurrence of fog. During the winter, storms and fronts move through the area, resulting in gusty and rainy conditions. Thunderstorms are relatively infrequent, occurring two or three times each year.

The average annual ceiling height for the cloud cover is approximately 1,000 feet, but often depends on the height of the base of a capping inversion layer. The entire south-central coastal region experiences a persistent subsidence inversion due to a Pacific high-pressure region. The temperature inversion occurs below the 4,500-foot level and caps the planetary boundary layer, effectively disconnecting it from the free tropospheric air masses. The average maximum daily inversion height over

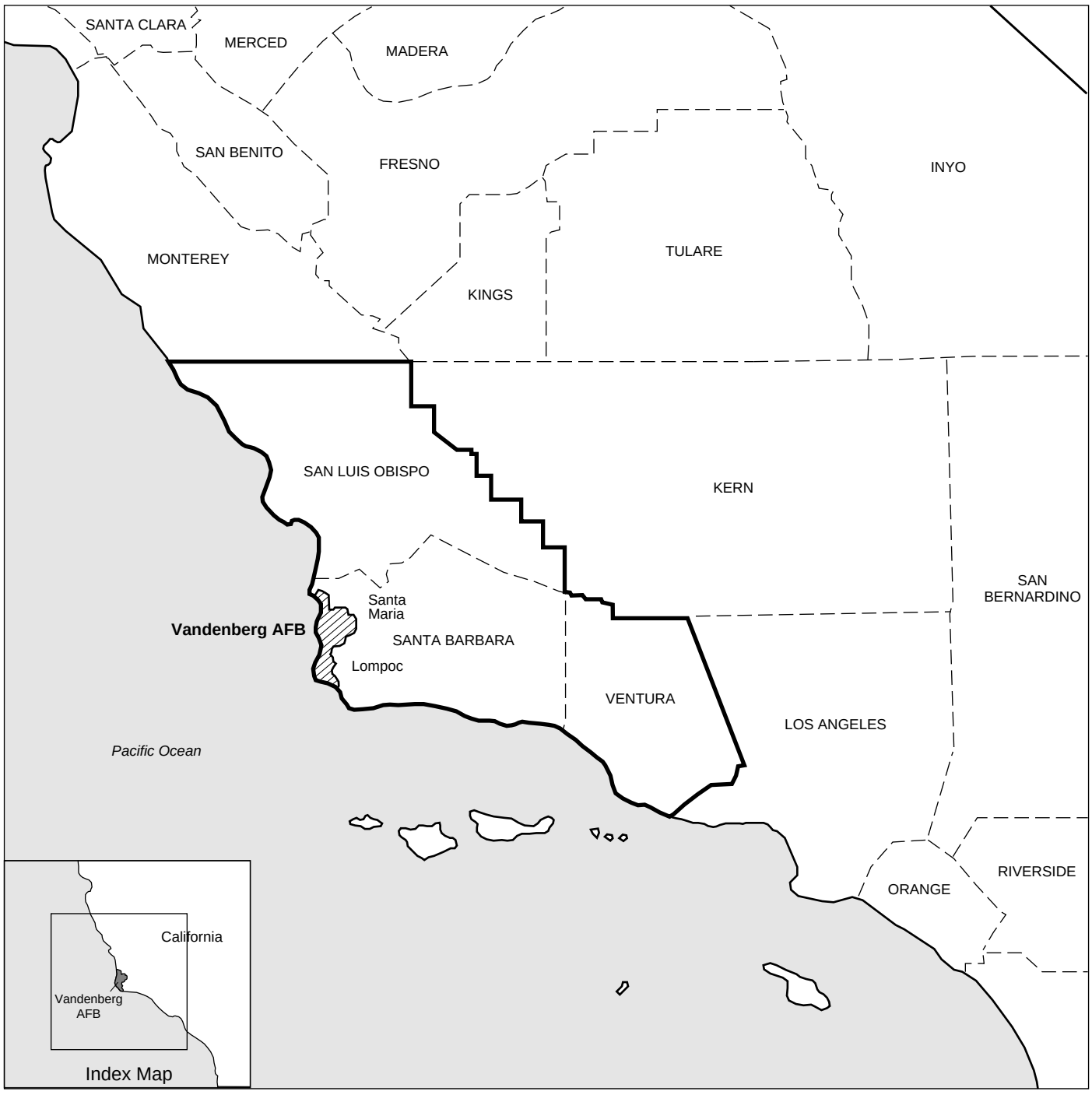
Point Arguello ranges from 1,600 feet during the summer to 2,800 feet during the winter (Holzworth, 1964).

3.10.3.3 Regional Air Quality. Information on how existing air quality is defined is provided in Section 3.10.2.2.

The CARB classifies areas of the state that are in attainment or nonattainment of the CAAQS. In California, air quality is assessed on a county and regional basis. Vandenberg AFB is in Santa Barbara County, which is part of the South Central Coast Air Basin (SCCAB) (Figure 3.10-2). The SCCAB includes the counties of San Luis Obispo, Santa Barbara, and Ventura and has been designated by both the U.S. EPA and CARB as being in attainment of the NAAQS and CAAQS for SO_2, NO_x, and CO, but as in nonattainment for ozone. Vandenberg AFB has been designated by the U.S. EPA to be unclassified for PM_{10} but has been designated by CARB to be in nonattainment of CAAQS for PM_{10}.

The U.S. EPA uses two categories to designate areas with respect to PM_{10}. These designations are nonattainment (areas that do not meet national standards) and unclassified (areas that cannot be classified). The levels for state and national PM_{10} standards may differ. For Santa Barbara County, the state PM_{10} 24-hour standard is 50 $\mu g/m^3$. The national PM_{10} 24-hour standard is 150 $\mu g/m^3$. Vandenberg AFB is designated as in non-attainment with the state PM_{10} standard only.

According to the federal classification, the SCCAB is designated as being in the “moderate” ozone nonattainment category (ozone concentrations between 0.138 to 0.160 ppm). An area designated as “moderate” is subject to a number of requirements.



EXPLANATION

Counties

South Central Coast Air Basin

Air Quality Region of Influence Vandenberg AFB

0 12.5 25 50 Miles

Figure 3.10-2

EELV/068

On September 2, 1997, the Federal Register published the EPA's proposed reclassification (Title 40 CFR 81) of Santa Barbara County from a moderate ozone nonattainment area to a serious ozone nonattainment area. This reclassification was proposed because Santa Barbara County had failed to attain the 1-hour ozone NAAQS by the statutory deadline of November 15, 1996. The reclassification will place more stringent requirements on the area. As discussed in Section 3.10.1, the NAAQS are being revised; these revisions may also affect the attainment status of Santa Barbara County.

The ROI for lower-atmosphere air quality resources may extend beyond the project boundaries to include those areas significantly affected by air dispersion and/or commuter traffic. This could include an area as large as the regional air quality basin (South Central Coast Air Basin) and may affect the maintenance of the NAAQS and the CAAQS for the Vandenberg AFB area.

Ambient air quality is measured at weather stations throughout California. The nearest air station for monitoring these data is on Vandenberg AFB. No data are available for 1995 lead concentrations. Table 3.10-8 shows 1995 average ambient air concentrations for criteria pollutants.

Table 3.10-8. 1995 Average Ambient Air Concentrations for Criteria Pollutants at Vandenberg AFB

Pollutant	Averaging Time	Concentration, $\mu g/m^3$
O_3	Hourly	150
NO_x	Hourly	18
SO_2	Hourly	18
	3 Hours	10.5
	24 Hours	5.3
PM_{10}	24 Hours	75.5
CO	Hourly	2,500
	8 Hours	2,150

CO = carbon monoxide
$\mu g/m^3$ = micrograms per cubic meter (approximate, converted from parts per million)
NO_x = nitrogen oxides
O_3 = ozone
PM_{10} = particulate matter equal to or less than 10 microns in diameter
SO_2 = sulfur dioxide

Source: Santa Barbara County Air Pollution Control District, 1997.

3.10.3.4 Air Emissions. Emissions inventory information for the affected environment was obtained from the SBCAPCD, the CARB, and Vandenberg AFB. Inventory data for each pollutant are reported in tons per year in order to describe the baseline conditions of pollutant emissions in the area.

The existing SBCAPCD Emissions Questionnaire lists emissions from stationary sources. This information has been included in Table 3.10-9. These emissions are for all stationary sources at Vandenberg AFB.

Table 3.10-9. Vandenberg AFB Baseline Emissions[a]

	VOC	NO_x	CO	SO_2	PM_{10}
Existing Launch Programs					
Vehicle Launches	0.0	1.7	0.0	0.0	30.8
Vehicle Preparation, Assembly, and Fueling	2.3	0.0	0.0	0.0	0.7
Mobile Sources	33.8	30.0	354.5	2.0	101.5
Point Sources	0.2	8.1	1.2	0.6	0.5
Total	36.3	39.8	355.7	2.6	133.4
Vandenberg AFB Stationary Sources (Emissions Questionnaire)[b]	4.2	21.3	1.2	7.7	2.1
Santa Barbara County Point Source	1,350	418	2,108	585	145
Santa Barbara County Area Source	43,314	13,576	100,401	705	29,229
Santa Barbara County Total	44,664	13,994	102,509	1,290	29,374

Note: (a) All emissions in tons per year for 1995.
(b) Includes stationary source emissions only.
CO = carbon monoxide
NO_x = nitrogen oxides
PM_{10} = particulate matter equal to or less than 10 microns in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compound

A baseline launch emissions inventory has been generated for the applicable launch activities in 1995. The baseline emissions included in this inventory are specifically for current launch vehicle systems (Atlas II, Delta II, and Titan IV), and support activities for the launch of those vehicles. This inventory includes estimates of emissions from the following key sources:

- Vehicle launch
- Vehicle preparation, assembly, and fueling
- Mobile sources such as support equipment, commercial transport vehicles (including trucks and aircraft), and personal vehicles
- Point sources such as heating/power plants, generators, incinerators and storage tanks.

Estimates are divided into two categories: emissions that are directly launch-related and infrastructure emissions. Launch-related emissions are estimated on a pounds-per-launch basis. Infrastructure emissions are estimated on a pounds-per-day basis and are assumed to take place regardless of the number of launches per year. Emissions comparisons are summarized in Table 3.10-9 for criteria pollutants.

Emissions from each of the key sources are calculated as described below.

Vehicle Launch. Table 3.10-10 lists vehicle launches from Vandenberg AFB in 1995. Emissions are addressed only for those vehicles being replaced (Atlas II, Delta II, Titan IV). Actual launch emissions are estimated using kinetics and flowfield models as described below. Emissions predicted to be below 3,000 feet in altitude are included in the inventory totals; emissions at altitudes above 3,000 feet are addressed in Section 3.11, Upper Atmosphere.

Table 3.10-10. 1995 Launches, Vandenberg AFB

Date	Vehicle	Launch Complex
March 24	Atlas E	SLC-3W
November 3	Delta II	SLC-2W
December 5	Titan IV	SLC-4E
April 3	Pegasus	L-1011
June 22	Pegasus XL	L-1011
August 15	Lockheed LLV	SLC-6

The standard TDK Nozzle Performance Computer Model is utilized to model the engine performance, as described in Section 3.10.2.2.

The emissions estimates presented in Table 3.10-9 are for normal launches and do not require any further modeling. Emission estimates were made using the launch trajectory information for LEO and GTO missions. The fraction of each propellant emitted below 3,000 feet, along with the height-dependent mass fractions from SPF-3, is used to estimate the emissions. Information on mission trajectory for each launch in Table 3.10-10 was not available, so for analysis purposes, it was assumed that 50 percent of launches would utilize a GTO trajectory, and 50 percent would utilize a LEO trajectory.

The emissions shown in Table 3.10-9 are totals for emissions from the selected 1995 launch vehicles and show the contribution of these launches to regional air quality. Local air quality impacts are addressed on a per-launch basis in the analysis within Section 4.10.

Vehicle Preparation, Assembly, and Fueling. For the two launches included in the 1995 baseline, much of the preparation and assembly operations took place at Vandenberg AFB. A discussion of emissions associated with these activities is provided in Section 3.10.2.2.

Total ODS emissions associated with the Atlas, Delta, and Titan operations are estimated to be 64 pounds for 1995 Vandenberg AFB operations.

Mobile Sources. Mobile emission sources are described in Section 3.10.2.2.

Vehicle Deliveries and Miscellaneous Supply Traffic

Methods and assumptions utilized to calculate emissions associated with these activities are described in Section 3.10.2.2.

Because the ROI for Vandenberg AFB includes all of the SCCAB, transportation emissions are calculated for all vehicular traffic that takes place in Santa Barbara, San Luis Obispo, and Ventura counties and is directly related to EELV activities.

Vehicle Assembly and On-Site Transport

Methods used to calculate emissions for these activities are described in Section 3.10.2.2.

Personal Automobile Use

Methods utilized to calculate emissions associated with these activities are described in Section 3.10.2.2.

Point Sources. Emissions from point sources such as spray booths and solvent cleaning equipment are included in the total emission calculations for vehicle preparation and assembly. Emissions from boilers and internal combustion engines are calculated based on the information provided in the 1995 Santa Barbara County Air Pollution Control District (APCD) Annual Emission Inventory Questionnaire. The emissions from these sources are attributed to the Atlas, Delta, and Titan programs for use in this baseline emissions inventory.

Hazardous Air Pollutants. Methods used to calculate HAPs emissions are described in Section 3.10.2.2. Baseline emissions of HAPs for Vandenberg AFB are summarized in Table 3.10-11.

Table 3.10-11. Vandenberg AFB Baseline HAPs Emissions[(a)]

	Cl_x	Hydrazine fuels	VOC HAP
Vehicle Launches	15.4	~0.0	0.0
Vehicle Fueling	0.0	>0.01	>0.01
Vehicle Coating/Solvent Use	0.0	0.0	2.3
Total	15.4	>0.01	2.3

Notes: (a) All emissions in tons per year.
Cl_x = chlorine compounds
HAP = Hazardous Air Pollutant
VOC = volatile organic compound

3.11 AIR QUALITY (UPPER ATMOSPHERE)

The atmosphere above 3,000 feet in altitude has been divided into two tropospheric layers (lower troposphere and upper troposphere) and the stratosphere. Immediately above the well-mixed, surface cloud layer at the Earth's surface (below 3,000 feet) lies the lower troposphere (3,000 feet to 10,000 feet). Air quality dispersion modeling for ambient pollutant concentrations that directly impact ground-level monitoring sites was conducted over the first 10,000 feet above the ground. This modeling region includes the mixed layer and the lower troposphere. Near-source modeling was conducted over the first 10,000 feet and within several tens of kilometers from the launch pad using the REEDM air quality model (Brady et al., 1997). Near-source modeling was conducted to determine if there would be immediate significant contributions of pollutant concentrations to the ambient concentrations of criteria and toxic pollutants that affect U.S. EPA and state and county air quality management plans. The upper troposphere lies between altitudes of 10,000 and 49,000 feet, where regional global-scale transport and dispersion of the rocket plume occurs. The stratosphere occupies altitudes between 49,000 and 164,000 feet.

3.11.1 Troposphere

The atmosphere above the mixed layer is generally referred to as the free troposphere. This portion of the atmosphere is continually stirred by the turbulence generally referred to as "weather". Removal of most of the rocket emissions from the free troposphere takes place over a period of less than a week, even at the top of the troposphere. Material is removed by rain-out and by vertical motions that bring material to the ground. With such removal processes, global buildup does not occur, and any potential air impact from rocket launches is confined to a spatial extent of less than several hundred kilometers downrange and downwind from the launch site.

The ROI for free tropospheric effects is essentially the same, regardless of the launch vehicle used.

Estimates of annual troposphere baseline emissions into the troposphere from Cape Canaveral AS and Vandenberg AFB were developed for 1995 and 1996. During this period, the most recent configurations of the Atlas, Delta, and Titan vehicles were launched (Table 3.11-1). These configurations include the Atlas IIAS, the Delta II 6825, and the Titan IV SRM. Five Atlas IIAS launches were made with strap-on SRMs during the 2-year period.

Specific data describing the configurations of the vehicles launched from Cape Canaveral AS and Vandenberg AFB during 1995 and 1996 are provided in Table 3.11-2.

Table 3.11-1. Launch Summary

Vehicle	1995 Vandenberg AFB	1995 Cape Canaveral AS	1996 Vandenberg AFB	1996 Cape Canaveral AS
Atlas II	0	10	0	6
Delta II	1	2	2	7
Titan IV	1	3	2	2
Total	6	23	8	23

AFB = Air Force Base
AS = Air Station

The emissions for each region were estimated from the following information:

(1) Total flight-time fraction for each engine in each layer
(2) The total propellant mass of each engine
(3) Each ODS's far-field mass fraction of the nozzle exit mass flow.

The total propellant mass emitted into each layer is estimated from the first two items described above. The amount of a specific chemical was estimated using the far field mass fraction. After-burning occurs in the troposphere, so in the tropospheric layers, CO was entirely converted to CO_2, and significant amounts of NO_x were generated. The HCl/Cl ratio is altered by after-burning; the emissions were estimated as Cl_x for the sum of the two chemicals. Both compounds are toxic and are treated cumulatively in this analysis. All aluminum compounds emitted from SRMs were treated as PM_{10}.

The total flight-time fraction is a function of the flight trajectory, which varies with respect to the mission specifics such as payload, desired orbit (height, eccentricity), and engine configuration. Although there can be some initial flight trajectory variation, the range of trajectories is somewhat limited. As a result, two trajectories representing the envelope of vehicle trajectories were used to estimate the flight-time fractions for each vehicle given its elapsed design burn time. The elapsed times at the top of each atmospheric layer are summarized in Table 3.11-3. For analysis purposes, it was assumed that 50 percent of launches would utilize a GTO trajectory, and 50 percent would utilize a LEO trajectory.

The fraction of the propellant burned in the 3,000 to 10,000-foot layer is estimated using the engine burn duration and the trajectory residence time in the lower troposphere. The height-dependent mass fractions of the ODSs resulting from each pound of propellant burned are obtained from predictions made using the after-burning flow field model (SPF-3). These fractions are used with the amount of propellant burned in each atmospheric layer to estimate the emissions of the ODSs in the tropospheric layers. Table 3.11-4 summarizes the annual emissions of the ODSs for launches from Cape Canaveral AS and Vandenberg AFB for 1995 and 1996. During after-burning, the majority of NO_x and CO_2 production occurs in the troposphere, whereas CO emissions are notable only in the stratosphere (see Section 3.11.2). Table 3.11-4 indicates that there are large differences in emission

Table 3.11-2. Summary of Atlas II, Delta II, and Titan IV Configurations Launched during 1995 and 1996

	Atlas IIA	Atlas IIAS	Delta II 7925	Titan IVA	Titan IVB
Core motor fuel type	LO_2/RP-1	LO_2/RP-1	LO_2/RP-1	N_2O/A-50	N_2O_4/A-50
Core motor fuel mass	348.4K lbs	348.4K lbs	212.6K lbs	335.5K lbs	338.4K lbs
Burn Duration	172 s	172 s	265 s	190 s	190 s
SRM Strap-on type	NA	Castor IVA	GEM	SRM	SRMU
Number of Strap-ons	NA	4	9	2	2
Fuel mass/ engine	NA	22.3K lbs	25.8K lbs	600K lbs	680K lbs
Burn duration	NA	56.2 s for each firing	63.0 s for each firing	122 s	137 s
Stage 1 fuel type	Same as core motor	Same as core motor	LO_2/RP-1	N_2O_4/A-50	N_2O_4/A-50
Stage 1 fuel mass	Included in core motor	Included in core motor	13.3K lbs	77.2K lbs	77.2k lbs
Burn duration	283 s	283 s	40 s	223 s	223 s
Stage 2 fuel type	LO_2/LH_2 (Centaur II)	LO_2/LH_2 (Centaur II)	A-50/N_2O_4	LO_2/LH_2 (Centaur II)	LO_2/LH_2 (Centaur II)
Stage 2 fuel mass	37.5K lbs	37.5K lbs	13.2K lbs	75.4K lbs	75.4K lbs
Burn duration	600 s	600 s	85.1 s	600 s	600 s

A-50	=	Aerozine-50
Castor IVA	=	older solid rocket motor (Thiokol)
GEM	=	graphite-epoxy motor
HTPB	=	hydroxyl-terminated polybutadiene
K	=	1,000
lbs	=	pounds
LH_2	=	liquid hydrogen
LO_2	=	liquid oxygen
NA	=	not applicable
N_2O_4	=	nitrogen tetroxide
RP-1	=	kerosene fuel (rocket propellant-1)
s	=	seconds
SRM	=	solid rocket motor
SRMU	=	solid rocket motor upgrade

Table 3.11-3. Flight Trajectories Used to Estimate the Fraction of Engine Burn Time in each Layer

Layer Designation	Layer top elevation (feet)	Trajectory 1 (GTO) (seconds)	Trajectory 2 (LEO) (seconds)
Lower atmosphere	3,000	29	19
Lower troposphere	10,000	50	33
Upper troposphere	49,000	95	72
Stratosphere	164,000	173	155

GTO = Geosynchronous Transfer Orbit
LEO = Low Earth Orbit

estimates at Vandenberg AFB between 1995 and 1996 (due to the different number of launches and vehicle type). Both years are presented for comparison; 1995 is used as the baseline year for consistency with the lower-atmosphere air quality discussion (see Section 3.10).

3.11.2 Stratosphere

Rocket launches can affect the atmosphere both in an immediate, episodic manner, and in a long-term, cumulative manner. The stratosphere is affected immediately after launch along the flight trajectory. Emissions from some types of launch vehicles significantly perturb the atmosphere along the launch trajectory at a range of a kilometer or less from the rocket passage. Ozone is temporarily reduced, an aerosol plume may be produced, and combustion products such as NO_x, chlorinated compounds, and reactive radicals can temporarily change the normal chemistry along the vehicle path.

The stratosphere exchanges mass with the troposphere beneath it at a relatively low rate. With no rain-out or other removal mechanisms, the rocket combustion products can build up in the stratosphere over time if there is a sufficient launch rate. When deposited into the stratosphere, ideally sized particulates (0.15 to 0.4 microns in size) such as alumina aerosols can persist for months and circle the globe. Aerosols that exist in the stratosphere can assist in catalyzing the destruction of ozone.

Gaseous chlorine compounds can also be sequestered in the stratosphere in a form that at some later date can be converted and contribute to ozone destruction anywhere over the globe.

The ROI for stratospheric effects is essentially the same, regardless of which launch vehicle is being used.

The lower boundary of the stratosphere lies between altitudes of 32,800 and 49,000 feet above the Earth's surface (with an atmospheric pressure in the range of 100 to 200 millibars [mb]) at a temperature inversion known as the tropopause, which extends up to nearly 164,000 feet (with an atmospheric pressure of about 1 mb). Although containing less than 20 percent of the atmosphere's mass, and despite having relatively little direct impact on

Table 3.11-4. Troposphere Emissions from Launches at Cape Canaveral AS and Vandenberg AFB, 1995 and 1996 (tons/year)

Chemical of Concern	CCAS 1995 Emissions		CCAS 1996 Emissions		VAFB 1995 Emissions		VAFB 1966 Emissions	
	Lower Troposphere	Upper Troposphere	Lower Troposphere	Upper Troposphere	Lower Troposphere	Upper Troposphere	Lower Troposphere	Upper Troposphere
PM	103	388	100	385	26	107	64.1	245
NO_x	5.6	13.8	4.5	12.4	1	2.9	2.5	6.7
CO	0.0	20.2	0.0	18.4	0.0	3.8	0.0	8.7
CL_x	52	196	51	195	13	54	32.3	123
VOC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SO_2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

CCAS = Cape Canaveral Air Station
CO = carbon monoxide
CL_x = chloride compounds
NO_x = nitrogen oxides
PM = particulate matter
SO_2 = sulfur dioxide
VAFB = Vandenberg Air Force Base
VOC = volatile organic compound

weather at the surface, the composition of the stratosphere can strongly influence the attenuation of solar radiation reaching the Earth's surface. Perturbations in the trace gas composition of the stratosphere by high-flying aircraft and rockets can potentially affect how the stratosphere absorbs and scatters the sun's radiation incident at its top. The environment at the Earth's surface can be affected by either changes in UV radiation or by changes in the balance of outgoing and incoming long- and short-wave solar radiation, which maintains the Earth's present climate. The stratospheric ozone burden is of key importance because it has a major influence on the surface UV flux and is a significant contributor to the global climatic heat budget. Nearly as important as ozone is the stratosphere's aerosol burden, which also determines the degree of solar attenuation. Because it contains halogens (chlorine, bromine), the aerosol can also perturb the stratosphere's ozone mass budget.

The Chemistry of the Stratosphere. The concentration profile of ozone varies with latitude. Most ozone is photochemically produced in the equatorial atmosphere and is transported polewards and downwards with time (Andrews et al., 1987). At 30° N latitude, which corresponds approximately to the latitude of the two launch facilities, the annual ozone peak concentrations occur at an altitude of approximately 70,000 feet. Ozone concentration varies seasonally, so that at 30° N latitude, the seasonal change in columnar ozone is on the order of 10-20 out of an average of 290 dobson units (World Meteorological Organization, 1989).

Considerable monitoring has found evidence of significant ozone decreases in both the Arctic and Antarctic polar regions (World Meteorological Organization, 1989). The most pronounced reductions, the so-called ozone "hole", occur during the spring near Antarctica. The cause is now known to be due chiefly to the appearance of at least one type of polar stratospheric cloud (PSC). PSCs form when the ambient air is sufficiently cold, sufficient water vapor is present, and when there is a sufficient lack of polewards mixing of warmer and drier air. A PSC acts to destroy ozone by freeing chlorine bound up in the chloro-nitrate pool via direct activation on frozen or super-cooled liquid surfaces within the cloud via a reaction such as: $ClONO_2 + HCl \rightarrow 2Cl + HNO_3$. The free chlorine and bromine rapidly destroy ozone in a catalytic cycle before being bound up again.

Injections of water and sulfur compounds can play a role in perturbing lower stratospheric ozone in the tropics and mid-latitudes without requiring extremely low temperatures for PSC formation. Water vapor, which can form PSCs, can also be injected into the lower stratosphere through the agency of intense cumulonimbus cloud systems. A single cloud can temporarily inject up to 100 metric tons of water or ice hydrometeors immediately above the tropopause (Cotton and Anthes, 1989). Much of the water and ice immediately precipitates out; however, some of the very smallest particles with very low fall velocities (e.g., submicron range) can persist for weeks.

Stratospheric aerosols can also originate from a number of terrestrial sources such as the sulfate produced by the oxidation of carbonyl sulfide diffusing up from the troposphere (Warneck, 1988). Volcanoes also directly inject aerosols and SO_2, which oxidizes to form a sulfate aerosol. Although the surface reactivity of such stratospheric aerosols may be relatively inefficient in

catalyzing ozone destruction, the large mass injections by volcanic eruptions, such as El Chicon, can produce substantial temporary reductions in columnar ozone over the entire northern hemisphere (World Meteorological Organization, 1989).

Nitrogen and N_2O can also perturb stratospheric ozone through several processes. N_2O is released naturally from bacterial processes in the soil. Overfertilization can greatly increase the emission rate. N_2O is also released from the oceans, which may be its primary source (Warneck, 1988). N_2O is relatively inert with a chemical lifetime in the troposphere measurable in years. As it is slowly mixed into the stratosphere, it is photolyzed to produce excited atomic oxygen which, in turn, produces nitric oxide. NO reacts rapidly with ozone and is a net catalytic destroyer of ozone in a pure oxygen atmosphere. NO_x is also introduced directly into the stratosphere via direct injection by high-flying aircraft and rockets.

The impact of space shuttle launches on the stratosphere has been studied (Jackman et al., 1996). In the Jackman study, a total of nine space shuttle and three Titan IVB launches were assumed per year. Chlorine emissions were assumed to be in the form of HCl. Such a fleet of launches would result in emissions of 725 tons of chlorine per year. This amount is equal to only 0.25 percent of the 300,000 tons of chlorine per year released from the breakdown of industrial halocarbons.

The resulting peak launch impacts on ozone concentrations are on the order of 0.1 to 0.2 percent (roughly 1 part in a thousand) of the average concentrations and occur between 131,240 and 164,000 feet at nearly the same latitude as launch. This peak impact region is well above the region of maximum ozone concentration, so the impact of columnar ozone will be considerably smaller. The Jackman study indicates a worst-case impact of total (columnar integrated) ozone reductions of 0.014 percent.

The stratospheric chemistry of alumina surfaces under stratospheric conditions has also been studied (Meads et al., 1994). The results of this study indicated that the reaction probabilities for critical chlorine reactions are typically an order of magnitude less than those for ice and water-rich nitrate aerosols. However, the alumina surfaces are considerably more reactive than the sulfuric acid aerosols found in the lower stratosphere in mid-latitudes. As a result, for regions where PSCs and water or ice aerosols are rare, such as in the tropical and mid-latitudes, the alumina aerosol surfaces may play an important role in expediting ozone destruction by halogen species if a sufficient atmospheric loading occurs. However, compared with the sulfate aerosol loading, the alumina loading from rocket launches is less than 1 percent of the sulfate aerosol even when there have not been any recent volcanic eruptions. Significant depletion due to alumina aerosol would be expected to be relatively local and transient given the rapid horizontal rate of dispersion of the rocket plume after launch (Beiting, 1997).

Chlorine is only one of several chemicals that can destroy ozone in the stratosphere. Only 19 percent of all ozone destroyed has been estimated to be destroyed by chlorine (Warneck, 1988). Reaction of ozone with NO results in 34 percent of total ozone loss. The reaction of ozone with atomic oxygen accounts for the second largest loss rate, nearly 26 percent. The rocket

engine perturbation to the stratospheric Chapman ozone chemistry is rather small. Over 100,000 tons of ozone per year enter from sources other than launch vehicles. Each launch introduces on the order of 100 tons, so launches add up to one part in 1,000.

Stratospheric Impacts by Rocket Emissions. As discussed for the troposphere, annual stratosphere baseline emissions estimates from Cape Canaveral AS and Vandenberg AFB have been developed for 1995 and 1996, based on the data presented in Tables 3.11-1 and 3.11-2.

The emissions for each region were estimated using the same criteria as described for the troposphere emissions. After release, HCl in the stratosphere suffers two fates; it either precipitates out of the stratosphere as aerosol, or a small portion is repartitioned to free chlorine.

The estimated annual emissions of ODSs in the stratosphere are presented in Table 3.11-5. Chlorine is the primary chemical of concern for ozone depletion. Over the 2-year period, launches contributed 4.4 percent of the chlorine emissions. Atlas IIAS, Delta II (23.2 percent), and Titan IV SRM launches contributed 72.4 percent. Almost all after-burning conversion of rocket exhaust products occurs in the troposphere. As a result, very little NO production occurs in the stratosphere, and CO emitted by combustion is no longer converted to CO_2 in the stratosphere.

Table 3.11-5. Stratosphere Emissions from Launch Operations at Vandenberg AFB and Cape Canaveral AS, 1995 and 1996 (tons/year)

	VAFB Emissions		CCAS Emissions	
ODS	1995	1996	1995	1996
PM	150	300	472	435
NO_x	0.6	1.2	1.8	356
CO	152	304	900	698
Cl_x	75	150	236	179

CCAS = Cape Canaveral Air Station
Cl_x = chlorine compounds
CO = carbon monoxide
NO_x = nitrogen oxides
ODS = ozone-depleting substance
PM = particulate matter
VAFB = Vandenberg Air Force Base

3.12 NOISE

Noise is usually defined as unwanted sound. It may be undesirable because it interferes with speech communication and hearing, is intense enough to damage hearing, or is simply annoying. High-amplitude noise can be unwanted because of potential structural damage. Noise is usually thought of as coming from man-made activities, but some natural sounds (e.g., insects, animals, wind, waves) are considered to be noise.

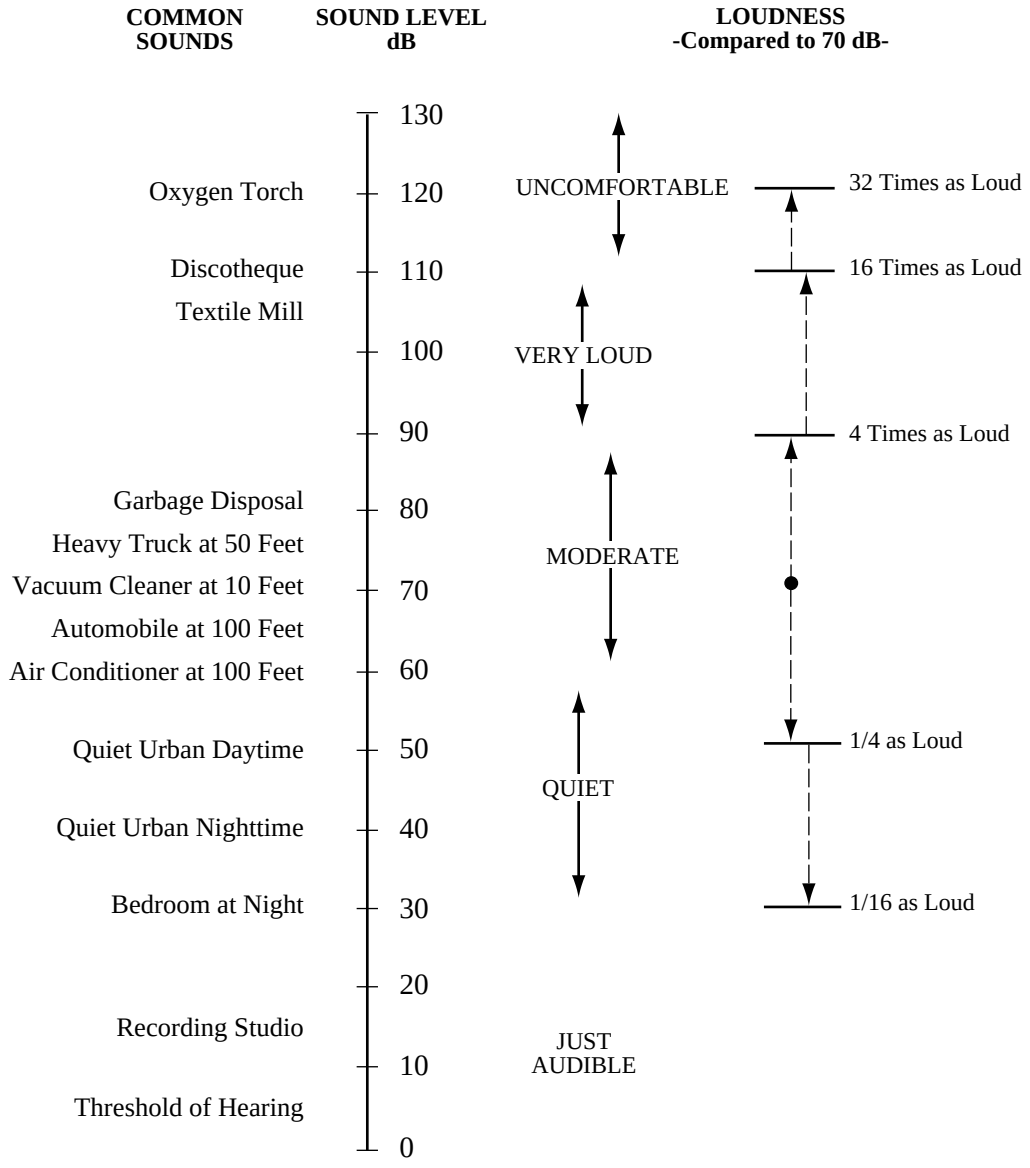
The characteristics of sound include parameters such as amplitude, frequency, and duration. Sound can vary over an extremely large range of amplitudes. The decibel (dB), a logarithmic unit that accounts for the large variations in amplitude, is the accepted standard unit for the measurement of sound.

Different sounds may have different frequency content. When measuring sound to determine its effects on a human population, it is common to adjust the frequency content to correspond to the frequency sensitivity of the human ear. This adjustment is called A-weighting (American National Standards Institute, 1988). Sound levels that have been so adjusted are referred to as A-weighted sound pressure level (AWSPL). The unit is still dB, but the unit is sometimes written dBA or dB(A) for emphasis. Figure 3.12-1 summarizes typical A-weighted sound levels.

If structural damage is a concern, then the overall sound pressure level (OSPL) is used. This quantity has no frequency weighting and therefore includes low frequencies that are not audible but can affect structures.

Noise levels usually change with time. A number of descriptors have been developed that account for this and provide a cumulative measure of noise exposure (Appendix F). The most widely used cumulative measure is the day-night average sound level (L_{dn} or DNL), a day-long average of the AWSPL, with a 10-dB penalty applied at night, from 10 pm to 7 am. The state of California uses the Community Noise Equivalent Level (CNEL), which is similar to L_{dn} except that a penalty of 5 dB is also applied to noise in the evening, from 7 pm to 10 pm.

A quantity falling between single-event measures like AWSPL and cumulative measures like L_{dn} is the sound exposure level (SEL), a measure of the total sound from a single event combining the level of the sound with its duration. The formal definition of SEL is presented in Appendix F. For a sound with an effective duration of one second, SEL is equal to AWSPL. For sounds with longer effective duration, SEL is larger than AWSPL and thus reflects the greater intrusion of the longer sound.



A-Weighted Sound Levels of Common Sounds

Figure 3.12-1

Source: Handbook of Noise Control, C.M. Harris, Editor, McGraw-Hill Book Co., 1979

The cumulative quantities L_{dn} and CNEL are based on sounds that occur on a regular basis, at least every day, and usually many times per day. An important part of the noise environment at both Cape Canaveral AS and Vandenberg AFB includes launches of existing launch vehicles. These events are relatively infrequent, at rates well below those needed for L_{dn} or CNEL to be meaningful. Emphasis in this EIS is therefore placed on single-event noise levels: AWSPL, OSPL, and SEL.

Three distinct noise events are associated with launch and ascent of a launch vehicle: on-pad rocket noise, in-flight rocket noise, and sonic boom. It is common to depict noise over an area by means of noise contours.

On-Pad Rocket Noise. On-pad rocket noise occurs when engines are firing but the vehicle is still on the pad. The rocket exhaust is usually turned horizontally by deflectors or an exhaust tunnel. Noise is highly directional, with maximum levels in lobes that are at about 45 degrees from the main direction of the deflected exhaust. Noise levels at the vehicle and within the launch complex are high. Because the sound source is at or near ground level, propagation from the rocket to off-site locations grazes along the ground and tends to experience significant attenuation over distance. On-pad noise levels are typically much lower than in-flight noise levels because sound propagates in close proximity to the ground and undergoes significant attenuation when the vehicle is on or near the pad.

In-Flight Rocket Noise. In-flight rocket noise occurs when the vehicle is in the air, clear of the launch pad, and the engine exhaust plume is in line with the vehicle. In the early part of the flight, when the vehicle's motion is primarily vertical, noise contours are circular. The sound source is also well above the ground and therefore experiences less attenuation as it propagates to large distances. The shapes of the contours for launch vehicle ascent are approximately circular, particularly for the higher levels near the center. The outer contours tend to be somewhat distorted. They can be stretched out in the launch direction or broadened across the launch direction, depending on specific details of the launch. Because the contours are approximately circular, it is often adequate to summarize noise by giving the sound levels at a few distances from the launch site. On-pad noise contours are much smaller than in-flight contours. Because in-flight noise is greater than on-pad noise, analysis in this study has concentrated on in-flight noise.

The major source of rocket noise is from mixing of the exhaust flow with the atmosphere, combustion noise in the combustion chamber, shock waves and turbulence in the exhaust flow, and occasional combustion noise from the post-burning of fuel-rich combustion products in the atmosphere. The emitted acoustic power from a rocket engine and the frequency spectrum of the noise can be calculated from the number of engines, their size and thrust, and their flow characteristics. Normally, the largest portion of the total acoustic energy is contained in the low-frequency end of the spectrum (1 hertz [Hz] to 100 Hz). Noise measurements conducted during a Titan IIID launch indicated that the maximum sound pressure levels occurred at around 20 to 50 Hz (U.S. Air Force, 1991).

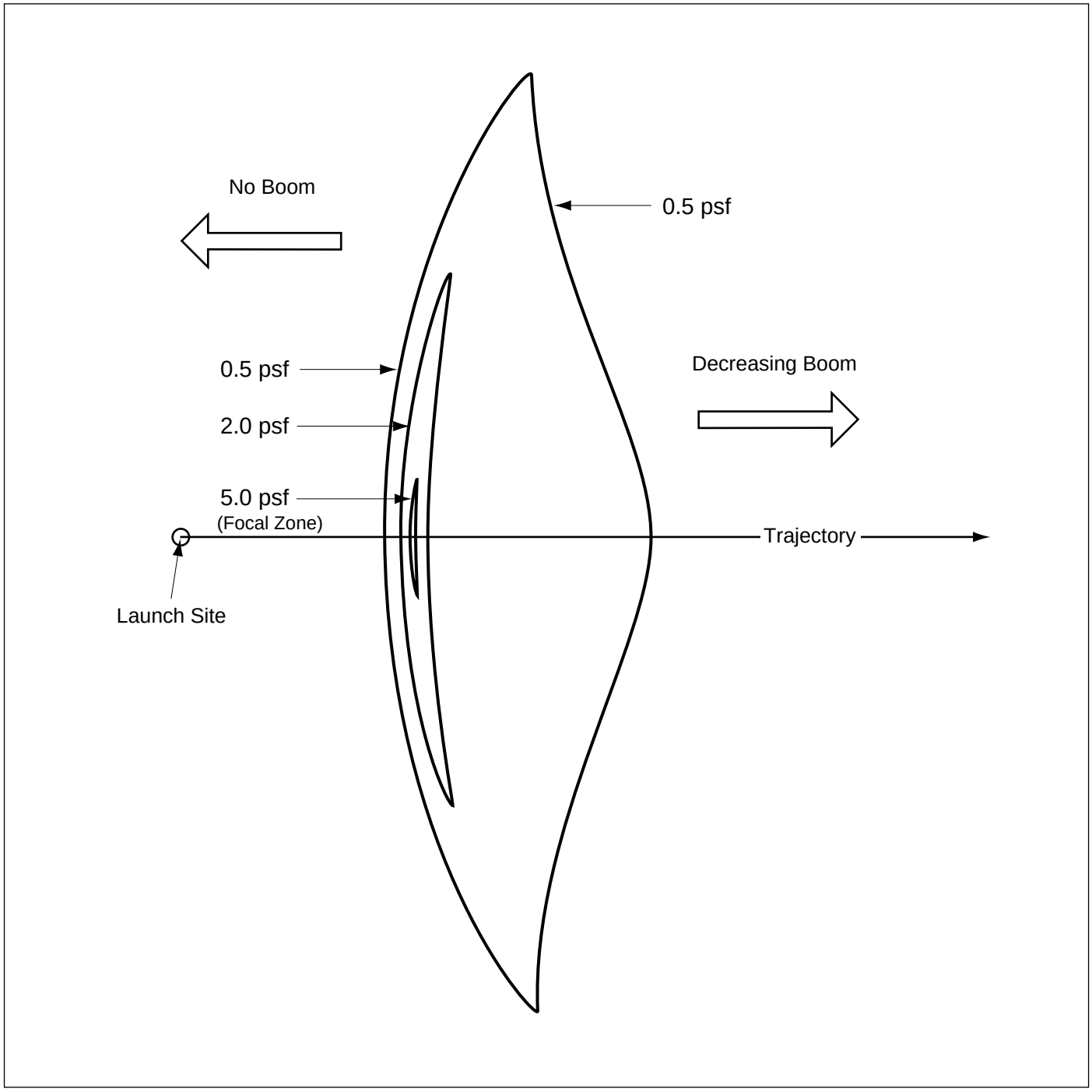
To evaluate the potential noise impact associated with launch and ascent, it is necessary to consider not only the overall sound level but the frequency spectrum and the duration of exposure. High noise levels can cause annoyance and hearing damage. OSHA has established noise limits to protect workers at their work places. According to these standards, no worker shall be exposed to noise levels higher than 115 dBA. The exposure level of 115 dBA is limited to 15 minutes or less during an 8-hour work shift (U.S. Air Force, 1992). The OSHA standards are the maximum allowable noise levels for the personnel in the vicinity of the launch pad. Off the base, concerns for noise are community annoyance, damage to fragile structures, and adverse effects on animals.

Sonic Boom. Another noise characteristic of launch vehicles is that they reach supersonic (faster than the speed of sound) speeds and will generate sonic booms. A sonic boom, the shock wave resulting from the displacement of air in supersonic flight, differs from other sounds in that it is impulsive and very brief (less than 1 second). Sonic booms are generally described by their peak overpressure in pounds per square foot (psf).

Figure 3.12-2 shows nominal noise contours for the sonic boom from a launch vehicle. The contour values represent psf, the unit used for sonic boom overpressures. The launch site is noted on the figure, and the launch direction is to the right. Regions within each contour experience overpressures equal to or greater than that denoted for the contour. The contours denote the peak pressure that occurs at each point over the course of the launch and do not represent noise at any one time. The sonic boom event at each position is brief, as noted in the preceding paragraph.

Because a sonic boom is not generated until the vehicle reaches supersonic speeds, some time after launch, the launch site itself does not experience a sonic boom. The crescent shape of the contours reflects this “after launch” nature of sonic boom. The entire boom footprint is downtrack, and the portions of the footprint to the side of the trajectory (up and down in the figure) represent the overpressures caused as the shock wave expands radially from the line of travel of the launch vehicle. There is actually no boom to the left of the contours shown, and the boom diminishes rapidly farther downtrack, to the right of the contours.

The 0.5-psf contour shown in Figure 3.12-2, although not to scale, has a shape similar to an actual low-overpressure sonic boom contour. The two higher contours, 2.0 and 5.0 psf, have been considerably distorted from typical actual contours for illustrative purposes. The crescent shape is correct, and the width across the trajectory (i.e., vertical height on the figure)



EXPLANATION

psf Pounds per square foot

Nominal Sonic Boom Contours for Ascent of a Launch Vehicle

Figure 3.12-2

Not to Scale

relative to that of the 0.5-psf contour is approximately correct. However, their width and position in the direction along the trajectory are greatly exaggerated for illustrative purposes. Typically, the left edge of these higher overpressures would be very close to the left edge of the 0.5-psf contour and would not appear as a distinct line when plotted to any reasonable scale. The right edge of these contours would also be much closer to the left than shown and would often not appear as distinct lines. The concentration of these contours is due to focusing of the boom as the vehicle accelerates. The focal zone "super boom" region is within the 5.0-psf contour illustrated in Figure 3.12-2 and is very narrow (typically less than 100 yards).

It is common to calculate sonic boom footprints with the assumption that the ground is hard and does not significantly attenuate the boom. This is usually a good assumption for most of the footprint. However, near the edges of the footprint, the boom approaches the ground at a shallow angle and is attenuated by the same process discussed previously for on-pad rocket noise. This is typically important in the outermost 20 percent of the width of the outermost contour (the 0.5-psf contour in Figure 3.12-2). The attenuated sonic boom in this region sounds like rumbling or distant thunder, rather than the distinct double bang usually associated with sonic booms.

Appendix F contains more detailed descriptions of noise and sonic boom. Effects of sonic booms on wildlife are addressed in Section 4.14, Biological Resources. The following two subsections describe the environments around each EELV launch site that may be affected by noise.

3.12.1 Cape Canaveral AS

Ambient Noise Levels Off Station. Most of the region surrounding Cape Canaveral AS is open water, with the Atlantic Ocean to the east and the Banana River to the west. Immediately north of Cape Canaveral AS is KSC; Port Canaveral is to the south. This relative isolation of the station reduces the potential for noise to affect adjacent communities. The closest residential areas to Cape Canaveral AS are to the south, in the cities of Cape Canaveral and Cocoa Beach. Expected sound levels in these areas are normally low, with higher levels occurring in industrial areas (Port Canaveral) and along transportation corridors. Residential areas and resorts along the beach would be expected to have low overall noise levels, normally about 45 to 55 dBA. Infrequent aircraft flyovers from Patrick AFB and rocket launches from Cape Canaveral AS would be expected to increase noise levels for short periods of time. Noise levels at KSC probably approximate those of any urban industrial area, reaching levels of 60 to 80 dBA. The launch of space vehicles from KSC does generate intense, but relatively short-duration, noise levels of low frequencies. The highest recorded levels are those associated with the space shuttle, which in the launch vicinity (i.e., on the pad and its supporting facilities) can exceed 160 dBA. Noise levels at Port Canaveral would be expected to be typical of those at an industrial facility, reaching levels of 60 to 80 dBA.

Noise and sonic boom patterns are oriented according to the launch azimuth. Azimuth is defined as horizontal direction expressed as the angular distance between the direction of a fixed point and the direction of the object; inclination is the angle between the orbital plane of a space object and the plane of the Earth's equator. Figure 3.12-3 shows the range of potential launch azimuths from Cape Canaveral AS.

Ambient Noise Levels On Station. An additional source of noise in the area is the Cape Canaveral AS Skid Strip. Because of the infrequent use of the skid strip, noise generally does not affect public areas. Other less frequent but more intense sources of noise in the region are space launches from Cape Canaveral AS. Current launches include Atlas, Delta, Titan, and Trident.

Noise from a Delta II launched from SLC-17 was measured during a July 1992 launch at four locations (McInerny, 1993a). Measurements were taken downrange at nominal distances of 1,500, 2,000, and 3,000 feet from the launch pad. Table 3.12-1 shows the noise levels (OSPL, AWSPL, and A-weighted SEL) measured during the launch at each location, and pre-launch predicted OSPL. Because launches from Cape Canaveral AS would occur intermittently, the resulting noise would not cause an increase in the equivalent sound pressure level (L_{eq}) (the average sound level over a period of time) in nearby areas.

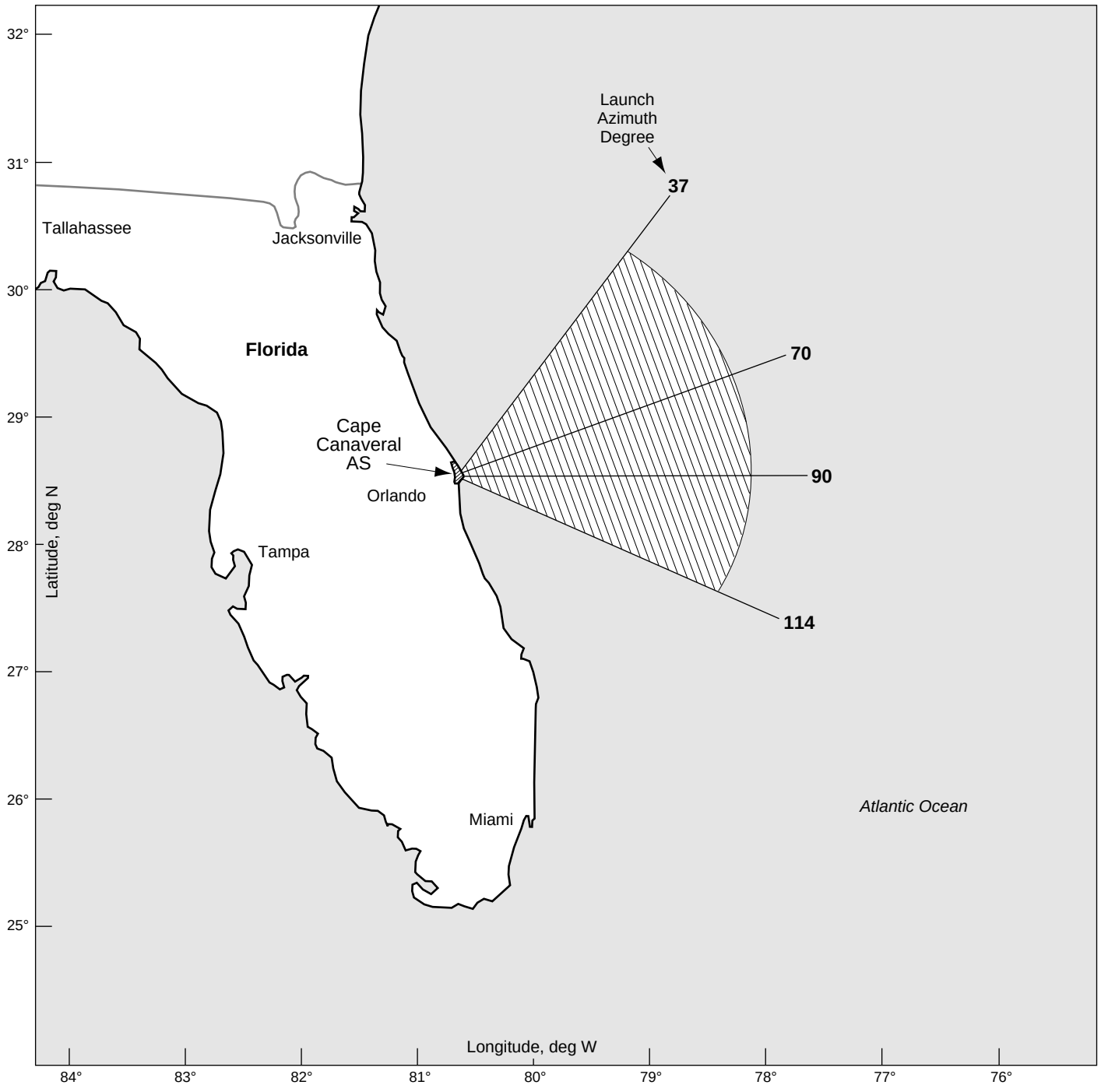
Table 3.12-1. Measured Delta II Sound Levels, July 1992

	Noise Levels (dB)			
Distance from Pad (feet)	Predicted Maximum OSPL	Measured Maximum OSPL	Measured Maximum AWSPL	Measured A-weighted SEL
1,500	135.4	130.6	120.2	127.5
2,000	132.9	130.4	117.7	125.5
3,000	129.4	125.8	115.1	123.0

AWSPL = A-weighted sound pressure level
dB = decibel
OSPL = overall sound pressure level
SEL = sound exposure level (A-weighted)

Source: McInerny, 1993a

Following lift-off, launch vehicles gain altitude, pitch over, and accelerate quickly. When flight speed exceeds the speed of sound, shock waves develop. When these shock waves intersect with the ground, they are of environmental concern as sonic booms. Sonic booms produced during vehicle ascent occur over the Atlantic Ocean and are directed in front of the vehicle.



EXPLANATION

Range of potential launch azimuths

Azimuth - Horizontal direction expressed as the angle between the direction of a fixed point and the direction of the object.

Potential Launch Azimuths, Cape Canaveral AS, Florida

0 16 32 64 Miles

Figure 3.12-3

EELV/092

Peak overpressures from large vehicles such as the Titan IVB approach 10 psf in focal zones (Downing, 1996). Sonic booms generated from launches at Cape Canaveral AS do not impact developed areas (45 Space Wing, 1996b).

Concept A ROI. The ROI for Concept A includes on- and off-station areas described above. Noise levels at SLC-41 would be similar to those in an urbanized industrial area when operations are taking place, averaging about 50 to 60 dBA, due to ongoing activities. Nighttime noise levels occurring when the facility is not in use would be lower due to limited activity and would be similar to those expected to be found in rural areas. Noise levels at this site increase with the launch of the Titan IVB from this complex. Expected noise levels from the Titan IVB would be similar to those launched from Vandenberg AFB (see Section 3.12.2).

Concept B ROI. The ROI for Concept B includes the on- and off-station areas described above. Because SLC-37 is not in use, expected noise levels would be typical of those in a rural environment, averaging 40 to 45 dBA. Noise levels would be expected to increase due to periodic traffic, use of nearby buildings, and the infrequent event of a launch from another launch complex.

Concept A/B ROI. The ROI for Concept A/B includes the off- and on-station areas for Concepts A and B described previously.

3.12.2 Vandenberg AFB

Ambient Noise Levels Off Base. The area immediately surrounding Vandenberg AFB is mainly undeveloped and rural, as discussed in Section 3.3.2.1, Regional Land Use, with some unincorporated residential areas within the Lompoc and Santa Maria valleys. The two urban areas in the region are the cities of Lompoc and Santa Maria, which support a few localized industrial areas. Sound levels measured for most of the region are normally low, with higher levels appearing in industrial areas and along transportation corridors. Rural areas in the Lompoc and Santa Maria valleys would be expected to have low overall CNEL levels, normally about 40 to 45 dBA. Infrequent aircraft flyovers and rocket launches from Vandenberg AFB would be expected to increase noise levels for short periods of time (City of Lompoc, 1996).

Urban areas are primarily affected by noise from automobiles, trucks, trains, and aircraft. CNEL contours have been measured based on typical sound levels in the Lompoc area. These contours show the highest CNEL levels (greater than 65 dBA) appearing around the Southern Pacific Railroad and major roadways, with lower CNEL levels (50 to 65 dBA) farther from main transportation corridors. Sound levels in Santa Maria are expected to be similar to those in Lompoc (City of Lompoc, 1996). Areas of higher localized noise levels would occur around stationary industrial sources. Presently, few of these stationary sources exist in the Lompoc and Santa Maria areas; consequently, overall sound levels are relatively low (U.S. Air Force, 1989a).

Ambient Noise Levels On Base. An additional source of noise in the area is the Vandenberg AFB Airfield, which follows state regulations concerning noise and maintains a CNEL equivalent to 65 dBA or lower for off-base areas. Two types of operations take place at this airfield: regular takeoffs and landings and touch-and-go maneuvers. Touch-and-go maneuvers are used for training purposes and create noise levels similar to regular aircraft takeoffs and landings (City of Lompoc, 1996).

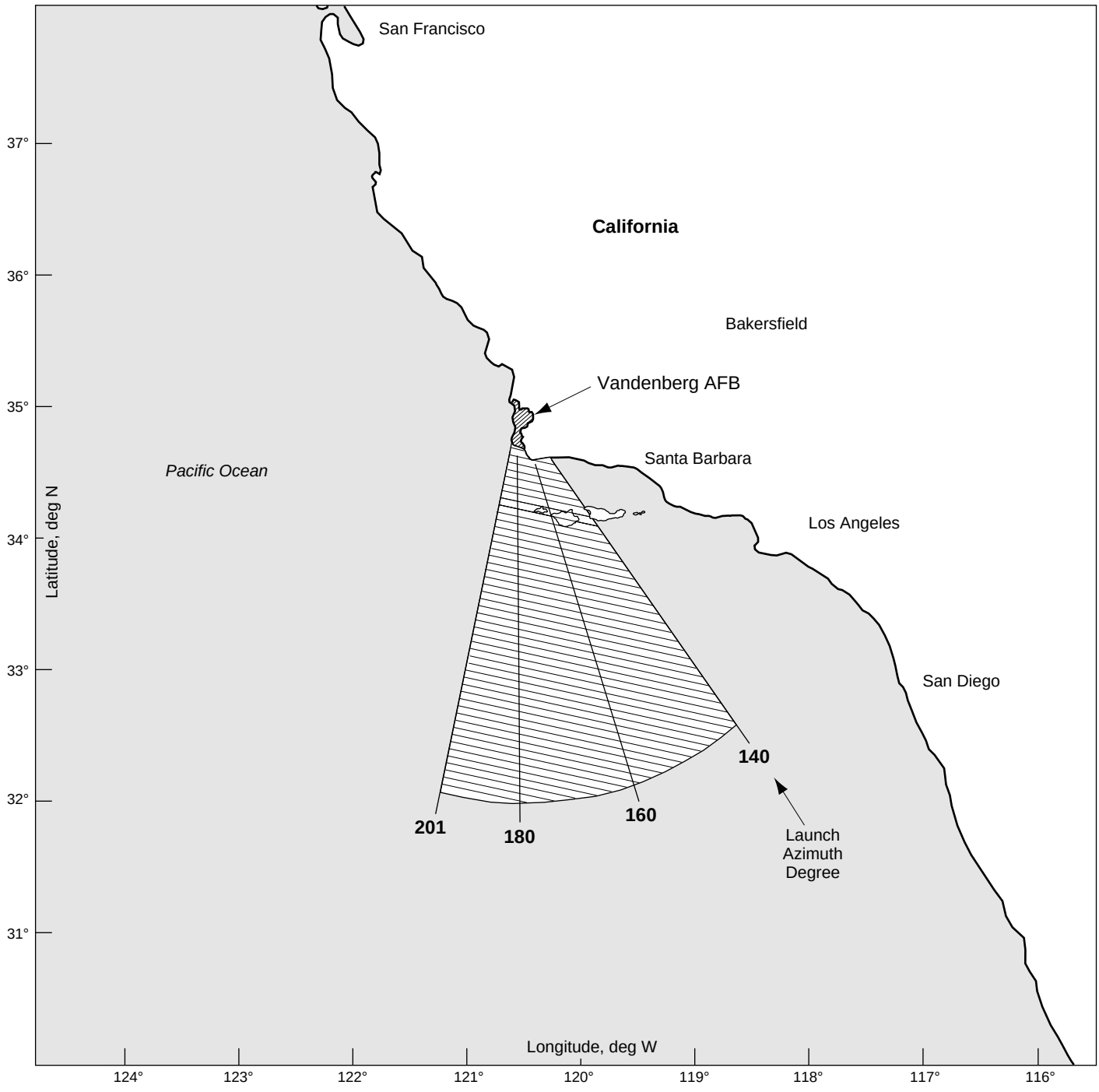
Other less frequent, but more intense, sources of noise in the region are rocket launches from Vandenberg AFB. Current Minuteman and Delta II launch activities are from North Vandenberg AFB, and Titan IV and Atlas II launches are from South Vandenberg AFB.

Noise and sonic boom patterns are oriented according to the launch azimuth. Figure 3.12-4 shows the range of potential launch azimuths from Vandenberg AFB.

Noise levels in Lompoc and Santa Maria from Minutemen rocket launches would be expected to be a maximum of 49 dBA and 74 dBA, respectively (U.S. Air Force, 1987c). Noise from a Titan IV launched from SLC-4 in August 1993 (Do, 1994) was measured at six locations. The Titan IV is the largest launch vehicle in the United States' military inventory and has the greatest potential for noise impacts. Measurement sites were located downrange at nominal distances of 2,700, 6,680, 11,200, 16,800, 19,000, and 43,129 feet from the launch pad. Data were tape recorded at all sites and processed into appropriate sound levels. Direct sound level meter measurements were made at 2,700, 11,200, and 19,000 feet. Table 3.12-2 shows the maximum noise levels during the launch measured at each location. Of interest is the measurement at the 43,129-foot site in the city of Lompoc: AWSPL was 88.0 dB, A-weighted SEL was 93.7 dB, and OSPL was 112.8 dB. Because launches from all of these facilities would occur intermittently, the resulting noise would not cause an increase in the average (L_{eq}, L_{dn} or CNEL) noise levels in nearby areas.

The maximum sonic boom overpressure for the Titan IVB was calculated and measured to be about 10 psf (Downing, 1996). Because most launch azimuths at Vandenberg AFB are over the Pacific Ocean, sonic boom effects on human population centers have been minor.

As discussed in Section 3.3.2.2, Vandenberg AFB Land Use, North Vandenberg AFB contains most of the base facilities, and South Vandenberg AFB is largely undeveloped with some scattered facilities. Noise levels measured on North Vandenberg AFB are generally typical of levels in urban areas with little industrialization. Noise levels on South Vandenberg AFB



EXPLANATION

Range of potential launch azimuths

Azimuth - Horizontal direction expressed as the angle between the direction of a fixed point and the direction of the object.

Potential Launch Azimuths, Vandenberg AFB, California

0 20 40 80 Miles

Figure 3.12-4

EELV/091

Table 3.12-2. Measured Titan IV Sound Levels, August 1993

Distance from Pad (feet)	Noise Levels (dB) Measured Maximum OSPL	SLM Measured OSPL	Measured Maximum AWSPL	Measured A-weighted SEL
2,700	141.7	141.0	124.4	133.0
6,680	131.4	-	112.4	121.9
11,200	129.0	129.9	110.6	116.2
19,000	122.1	127.6	99.0	109.0
43,129[(a)]	112.8	-	88.0	93.7

Note: (a) In City of Lompoc
AWSPL = A-weighted sound pressure level
dB = decibel
OSPL = overall sound pressure level
SEL = sound exposure level (A-weighted)
SLM = sound level meter

Source: Do, 1994

would be expected to be similar to levels found in rural areas, except around active launch complexes, where noise levels during operations may be similar to those at an industrial site.

Concept A ROI. The ROI for Concept A includes the on- and off-base areas described above. Although the SLC-3W site is not currently in use, noise levels there would be similar to those in an urbanized industrial area because of activities at nearby SLC-3E, averaging about 50 to 60 dBA, due to ongoing activities. Nighttime noise levels would be lower due to limited activity and would be similar to those expected to be found in rural areas of South Vandenberg AFB, about 40 to 45 dBA. Noise levels would be expected to increase due to trains passing on the nearby Southern Pacific Railroad, aircraft flyover, or the infrequent event of a launch from another launch complex.

Concept B ROI. The ROI for Concept B includes the on- and off-base areas described above. Noise levels at the SLC-6 site would be similar to those in an urbanized industrial area when operations are taking place, averaging about 50 to 60 dBA due to ongoing activities. Nighttime noise levels would be lower due to limited activity and would be similar to those expected to be found in rural areas of South Vandenberg AFB, about 40 to 45 dBA. Noise levels would be expected to increase due to trains passing on the nearby Southern Pacific Railroad, aircraft flyover, the construction of the California Spaceport, or the infrequent event of a launch from another launch complex.

Concept A/B ROI. The ROI for Concept A/B includes the off- and on-base areas for Concepts A and B described above.

3.13 ORBITAL DEBRIS

Orbital debris is a concern as a potential collision hazard to spacecraft. De-orbiting debris (i.e., debris re-entering the atmosphere from orbit) is a potential concern as a source of deposition of small particles into the stratosphere, and a possible contributor to stratospheric ozone depletion. Large pieces of debris are of concern with respect to re-entry and eventual Earth impact. The term “orbital debris” or “space debris” is used to refer to all earth-orbiting objects except active satellites (spacecraft) (i.e., payloads performing some type of operation or mission). Earth-orbiting debris can be classified as either natural or man-made objects. Natural objects consist of meteoroid material that travels through space. The measured number of man-made debris particles exceeds that of the meteoroid material particles, except in the 0.0004- to 0.04-inch range. The following sections address man-made debris only.

Man-made debris consists of material left in Earth orbit from the launch, deployment, and deactivation of spacecraft. It exists at all inclinations and primarily at LEO altitudes of approximately 217 to 1,243 miles. Orbital debris moves in many different orbits and directions, at velocities ranging from 2.5 miles per second to over 4 miles per second (Office of Technology Assessment, 1990).

Although space debris is not explicitly mentioned in any U.S. legislation, an Executive Branch policy directive, *National Space Policy* (September 19, 1996), identifies the following guidance to support major U.S. space policy objectives:

> “The United States will seek to minimize the creation of space debris. NASA, the Intelligence Community, and the DoD, in cooperation with the private sector, will develop design guidelines for future government procurements of spacecraft, launch vehicles, and services. The design and operation of space tests, experiments and systems, will minimize or reduce accumulation of space debris consistent with mission requirements and cost effectiveness.” (Intersector Guidelines [2] Space Debris [a]).

To date, no design guidelines have been agreed to, issued, or published (Huang, 1997; Johnson, 1997).

3.13.1 Characteristics of Orbital Debris

Salient characteristics of orbital debris include the orbital regimes in which it is found; its sources; debris particle size; estimated population; altitude distribution; and orbital lifetime.

Orbital Regimes. The space around the Earth in which satellites operate is generally divided into four regimes: LEO, medium Earth orbit, geosynchronous Earth orbit, and "other." Most cataloged orbital debris occurs in LEO because most space activity, particularly commercial, has traditionally occurred at those altitudes. LEO occurs at altitudes less than 1,243 miles, with orbital periods of 127 minutes or less. The boundary between LEO and higher orbits is not well defined. Medium Earth orbit occurs

between low and geosynchronous Earth orbits and is a semi-synchronous orbit with a period of approximately 12 hours. Geosynchronous Earth orbit is occupied by objects orbiting at an altitude of 22,238 miles, with an orbital period of approximately 24 hours. Geostationary Earth orbit is a special case of geosynchronous Earth orbit in which the object orbits above Earth's equator at an angular rotation speed equal to the rotation of the Earth. It thus appears to remain stationary with respect to a point on the equator. The fourth regime, "other", is defined by highly eccentric and geosynchronous transfer orbits that transit between LEO and higher orbital altitudes (Office of Technology Assessment, 1990).

Sources of Orbital Debris. Historically, the largest uncontrolled addition to orbital debris has been the breakup of launch vehicle upper stages (Loftus, 1989), which appears to be caused by pressure-vessel failure due to either deflagration or detonation of propellants remaining in the tanks, stress failure of the vessels, or reduction of pressure-vessel integrity by collision with meteoroids or other space objects (Loftus, 1989). In January 1981, a Delta second stage exploded in orbit, resulting in a large amount of orbital debris. Since 1981, however, a depletion burn to eliminate excess fuel after placing the payload in orbit has been performed on all Delta stages. Although explosions have occurred in the lower atmosphere, no orbital Delta stages have exploded since this practice was implemented, and future explosions of Delta stages in orbit are highly improbable (Kessler, 1989).

Debris Particle Size. Orbital debris particles can be characterized by size as follows:

- Small - Debris particles smaller than 0.4 inch in diameter. They are too small to be detected by sensors and are considered essentially "invisible".

- Medium - Debris particles between 0.4 and 4 inches in diameter. These medium-sized particles are unlikely to be detected by the Space Surveillance Network.

- Large - Debris particles larger than 4 inches in diameter. This regime represents 5 percent of the total population of debris particles larger than 0.4 inch in size. Particles of this size can be tracked and cataloged by the Space Surveillance Network.

A worldwide array of sensors, the Space Surveillance Network, tracks large pieces of orbital debris through the use of radar and ground telescopes. The AFSPC currently maintains a catalog of almost 8,000 tracked objects in space that are 4 inches or larger in size. As of November 1, 1995, there were 5,747 objects in LEO, 134 in medium Earth orbit, 601 in geosynchronous Earth orbit, and 1,447 in the "other" orbital regime. Only objects that can be consistently tracked and whose source can be identified are entered into the catalog (Office of Science and Technology Policy, 1995).

Debris Population. What is known about the debris population is derived from the worldwide network of sensors (optical, electro-optical, conventional radar, phased-array radar, and interferometer sensors) that can detect objects in space of varying sizes. The National Research Council estimates that there

are more than 10,000 objects greater than 4 inches in size in orbit (including the almost 8,000 tracked by AFSPC), tens of millions between 0.039 and 4 inches in size, and trillions less than 0.039 inch in size (National Research Council, 1995). However, there is no universal agreement on these numbers, with most analysts agreeing that neither the number nor the distribution of objects is well known. An estimated 99.5 percent of the orbital debris is between 0.039 and 4 inches in size, but 99.95 percent of the mass of orbital debris is estimated to consist of objects greater than 4 inches in size (Office of Science and Technology Policy, 1995).

The quantity of orbital debris has been growing at a roughly linear rate, and growth is projected to continue into the future. Between 1981 and 1994, an average of 100 launches worldwide occurred annually (Office of Science and Technology Policy, 1995). A high-velocity collision between two objects could produce many objects, increasing the likelihood of additional collisions in that orbit. As additional collisions occur, the likelihood of additional collisions increases further, producing an exponential growth in the debris population (National Research Council, 1995). This mechanism is incorporated in NASA, European Space Agency, and Russian debris models, which predict an increasing probability of orbital collisions over time. However, it is not yet considered sufficiently validated by the DoD to incorporate into DoD models (Office of Science and Technology Policy, 1995).

Altitude Distribution. The altitude distribution of all orbiting debris is unknown due to tracking limitations. As the altitude increases, the minimum-sized detectable objects increase due to sensor limitations. With the exception of a slight concentration near the poles, objects are spread uniformly over the surface of the Earth (Kessler, 1988).

Orbital Lifetime/De-orbiting Debris. Orbiting objects lose energy through friction with the upper reaches of the atmosphere and various other orbit-perturbing forces. Over time, the object falls into progressively lower orbits and eventually falls to Earth. As the object's orbital trajectory draws closer to Earth, it speeds up and outpaces objects in higher orbits. Once the object enters the measurable atmosphere, atmospheric drag will slow it down rapidly and cause it either to burn up or deorbit and fall to Earth. For example, unless reboosted, satellites in circular orbits at altitudes of 124 to 248 miles re-enter the atmosphere within a few months. At 248- to 559-mile orbital altitudes, orbital lifetimes can exceed a year or more depending on the mass and area of the satellite. Above 559-mile altitudes, orbital lifetimes can be 500 years or more (Interagency Group [Space], 1989). Figure 3.13-1 shows the relationship between altitude and orbital lifetime.

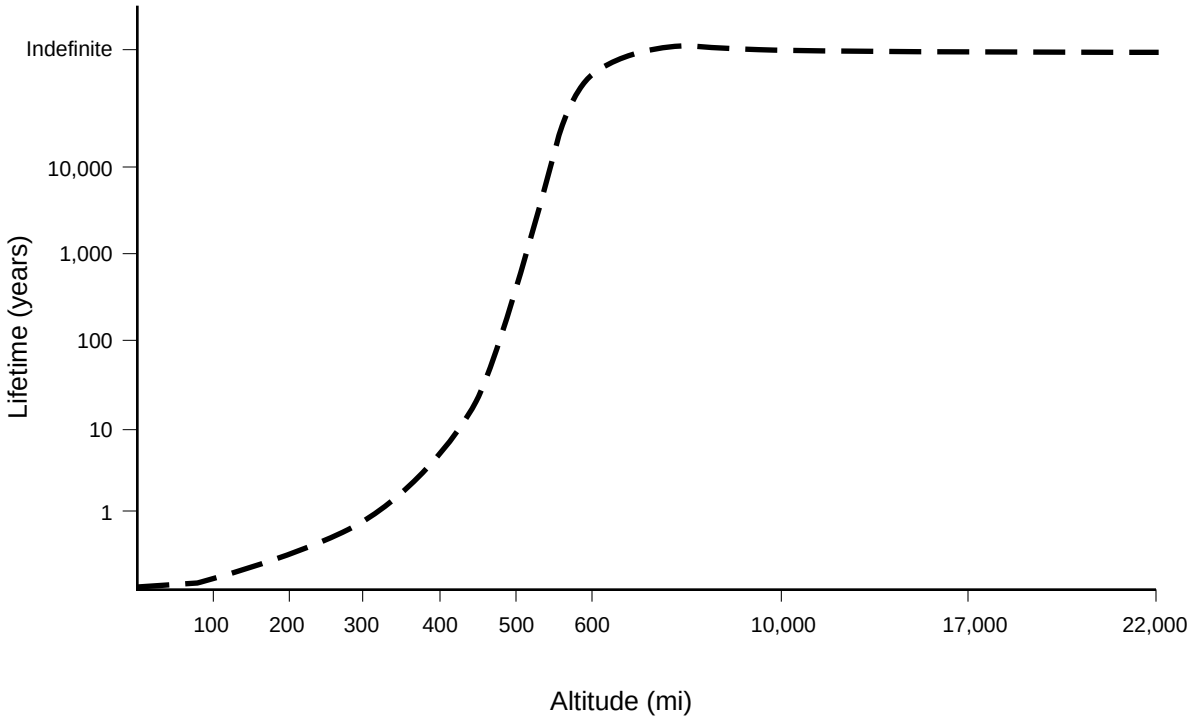
Both satellite and orbital debris Earth orbit lifetimes are a function of drag and ballistic coefficients. The greater the mass per unit area of the object, the greater the ballistic coefficient and the less the object will react to atmospheric drag. For example, a fragment with a large area and low mass (e.g., aluminum foil) has a lower ballistic coefficient and will decay much faster (have a shorter orbital life) than a fragment with a small area and high mass (e.g., a ball bearing). The combination of a variable atmosphere and unknown ballistic coefficients of orbital debris make decay and re-entry prediction difficult and inexact (Interagency Group [Space], 1989).

Orbital lifetimes for objects in elliptical orbits can vary significantly from lifetimes of objects in circular orbits. For elliptical orbits, the lower the perigee altitude (the point in the orbit that is nearest to the center of the Earth), the greater the atmospheric drag effects. Therefore, considering a circular and an elliptical orbit with equal energies, an object in an elliptical orbit will have a higher apogee (the point in the orbit that is at the greatest distance from the center of the Earth) decay rate and a shorter on-orbit lifetime (Interagency Group [Space], 1989). Solar-lunar perturbations act on debris in a highly elliptical orbit to either raise or lower the perigee, and therefore affect de-orbiting rates (Johnson, 1987).

3.13.2 Uncertainty in the Orbital Debris Environment

A large degree of uncertainty exists in understanding the current orbital debris environment. The uncertainties in assessing the debris environment include the number, density, mass, and the size of orbital debris. For orbital debris larger than 4 inches, it is generally accepted that the LEO environment has been measured reasonably adequately by space surveillance sensors, and these data provide a basic estimate of the orbital debris population.

Mathematical models of spacecraft or rocket body breakups are used to predict the size and number of fragments smaller than 4 inches. These predictions are then compared with limited telescope and special radar observations. The difference between the expected number of objects to be detected and the number actually observed becomes an estimate of the uncertainty of the populations. Based upon these data, the population density of the measured debris is known to an uncertainty factor of two to



Estimated Orbital Lifetime

Note: Lifetime is a function of atmospheric drag, ballistic coefficient, and solar activities.

Figure 3.13-1

five, depending on the diameter of the debris. However, for debris 0.4 to 4 inches, there are no confirmed measurements, and the estimates are based on linear extrapolation, which has an uncertainty factor of 10 (Interagency Group [Space], 1989).

Uncertainties in the natural decay process add to the degree of overall uncertainty. Natural decay is usually the result of atmospheric drag, solar-lunar perturbations (for highly elliptical orbits), or solar radiation pressure (for very light objects). Solar flares affect the rate of debris decay and contribute to the uncertainty. A major parameter in orbital decay is atmospheric density at the altitude of the orbiting object, which is also a function of the level of solar activity at any given altitude. Therefore, the more accurate the solar activity and atmospheric density prediction, the more accurate the debris decay prediction. However, forecasting solar activity is not an exact science (Kessler, 1988).

Other factors that contribute substantially to the uncertainty in the orbital debris environment include lack of predictability in the level of future space activities, including the types of activities, and lack of understanding of the causes of explosion/collision-induced satellite breakups. As noted above, these breakup events are the major sources of orbital debris. As commercial and foreign agencies enter the space arena, there will be more opportunities for debris generation. Although the exact cause of most breakups is unknown, it is generally thought that they are most often the result of inadvertent mixing of hypergolic fuels, overheating of residual propellants, or deliberate fragmentation (Johnson, 1987).

3.13.3 Hazards to Space Operations from Orbital Debris

The effects of launch-vehicle-generated orbital debris impacts on other spacecraft would depend on the altitude, orbit, velocity, angle of impact, and mass of the debris. Debris less than about 0.004 inch in diameter can cause surface pitting and erosion. Over a long period of time, the cumulative effect of individual particles colliding with a satellite might become significant because the number of particles in this size range is very large in LEO. Long-term exposure of payloads to such particles is likely to cause erosion of exterior surfaces and chemical contamination, and may degrade operations of vulnerable components such as optical windows and solar panels. Debris between 0.004 and 0.4 inch in diameter would produce significant impact damage that can be serious, depending on system vulnerability and defensive design provisions. Objects larger than 0.4 inch in diameter can produce catastrophic damage. Although it is currently practical to shield against debris particles up to 0.4 inch in diameter (a mass of 0.05 ounce), for larger sizes of debris, current shielding concepts become impractical (Office of Science and Technology Policy, 1995).

Solid rocket motors eject aluminum oxide dust (typically less than 0.004 inch) into the orbital environment, and may release larger chunks of unburned solid propellant or slag. However, solid rocket motor particles typically either decay very rapidly, probably within a few perigee passages, or are dispersed by solar radiation pressure. Thus, the operational threat of solid rocket motor dust is probably limited to brief periods of time related to specific mission events (Office of Science and Technology Policy, 1995).

Orbital debris generated by launch vehicles contributes to the larger problem of pollution in space that includes radio-frequency interference and interference with scientific observations in all parts of the spectrum. For example, emissions at radio frequencies often interfere with radio astronomy observations (Office of Technology Assessment, 1990). Not only can orbital debris interfere with the performance of scientific experiments, but it can even accidentally destroy them (Scheraga, 1986).

3.14 BIOLOGICAL RESOURCES

The ROI for biological resources includes the native and introduced plants and animals within the area potentially affected by construction activities and launch operations. For discussion purposes, these are divided into vegetation, wildlife (including aquatic biota), threatened or endangered species, and sensitive habitats. Appendix G provides lists of plants and animals potentially occurring in the vicinities of Cape Canaveral AS (Table G-1) and Vandenberg AFB (Table G-2).

The vegetation and wildlife subsections focus on those species expected to be present in habitats adjacent to the project area sites, aquatic species that could be affected by water quality changes, and birds and mammals of the offshore waters, islands, estuaries, lagoons, and wildlife refuges that could be affected during launch operations. Sensitive species (i.e., former federal Category 2 species, state species of special concern, and regionally rare and declining species) are included in this discussion. Federally and state-listed threatened and endangered species are discussed under a separate subsection.

Sensitive habitats include wetlands, plant communities that are unusual or of limited distribution, and important seasonal use areas for wildlife (e.g., migration routes, breeding areas, crucial summer/winter habitats). They also include critical habitat as protected by the Endangered Species Act and sensitive ecological areas as designated by state or federal rulings.

Information used in developing this section includes current and historical aerial photographs, numerous survey reports including wetland delineation survey reports, interviews with local experts, site visits in February and March 1997, National Wetlands Inventory data, and natural resource data.

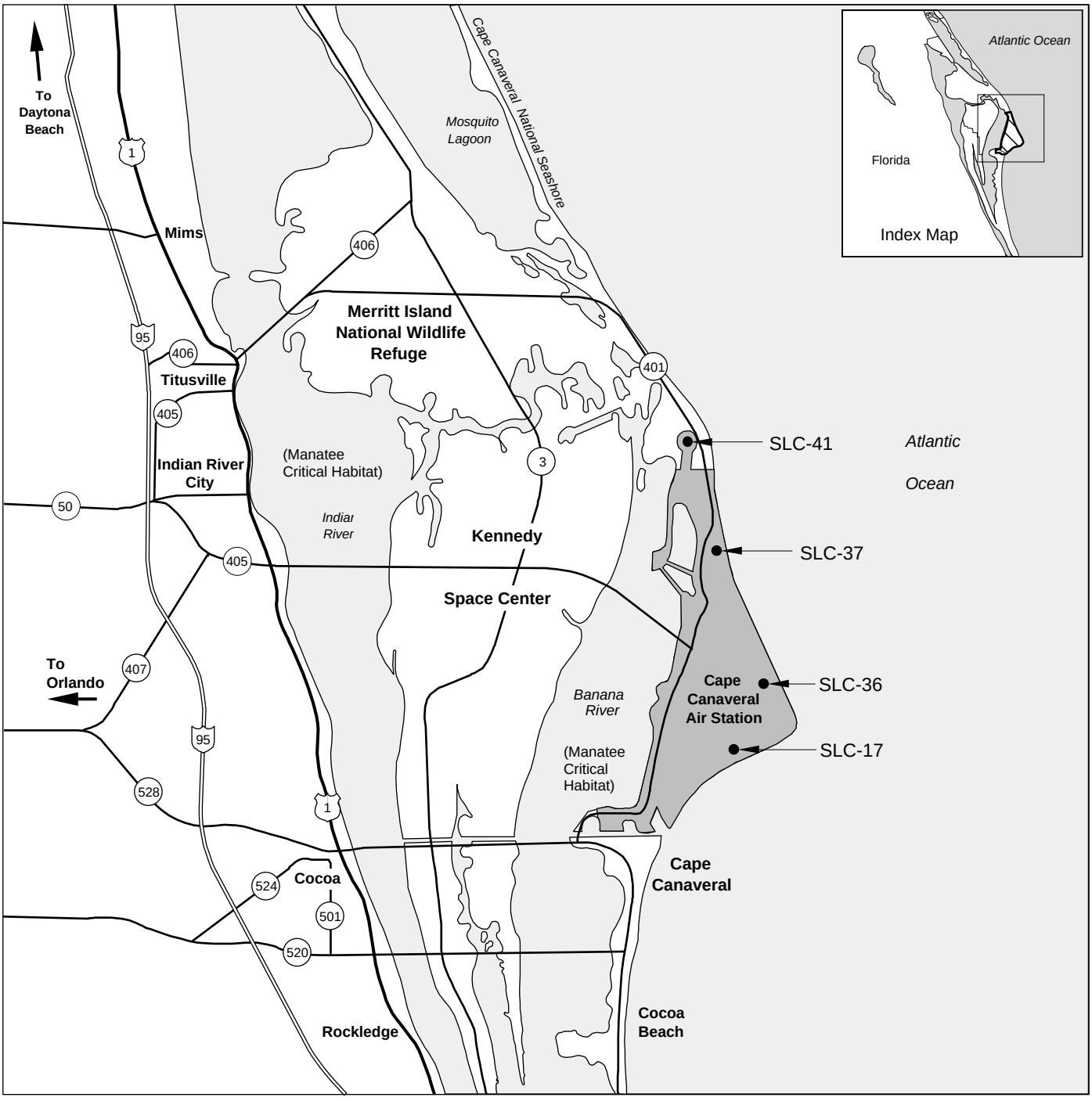
3.14.1 Cape Canaveral AS

Cape Canaveral AS occupies 15,800 acres of coastal habitat on a barrier island complex that parallels Florida's mid-Atlantic coast. The ROI for biological resources consists of Cape Canaveral AS and the surrounding land and adjacent Atlantic Ocean vicinities that could be affected by construction activities and effects from launch operations. Included in the ROI are three major water bodies, other than the Atlantic Ocean, that could be subjected to indirect launch effects, depending on the prevailing wind direction: the Banana and Indian rivers and the Mosquito Lagoon (Figure 3.14-1).

3.14.1.1 Vegetation. Cape Canaveral AS has a series of ridges and swales parallel to the coastline that support several ecologically significant natural communities, even though the communities are highly fragmented by mission-related construction and clearing. At least 10 high-quality natural communities exist on Cape Canaveral AS: oak scrub, rosemary scrub, maritime hammock, coastal strand, coastal dunes, grasslands, seagrasses, and three wetland communities (hydric hammock, interdunal swales, and estuarine tidal swamps and marshes).

Vegetation on the station consists mainly of the indigenous Florida coastal scrub (including oak and rosemary scrub), and xeric and maritime hammocks. These scrub habitats contain the non-native nuisance plant, the Brazilian pepper, which invades these communities along disturbed areas, and then becomes established as it outcompetes native species. Coastal strand, coastal dune, and grasslands can be found along the 13 miles of shoreline along the Atlantic Ocean. Seagrasses are found in the nearby rivers. Numerous wetlands and associated vegetation communities including hydric hammock, interdunal swales, and estuarine tidal swamps and marshes can be found on Cape Canaveral AS and its 12-mile shoreline along the Banana River. The remaining areas are associated with the cleared launch complexes and support facilities (National Aeronautics and Space Administration, 1996). Wetlands are discussed under Sensitive Habitats.

Oak scrub consists of densely growing shrubs that include myrtle oak, sand live oak, saw palmetto, and Chapman oak. Scrub is a fire-maintained community with hot, intense fires occurring every 20 to 80 years. Prior to modern development, these oak scrub communities would have burned frequently from lightning-strike fires. However, fire suppression has caused the scrub to become so densely vegetated that, if burned, it would result in a catastrophic fire that would completely remove the vegetation from the area. The Integrated Natural Resources Management Plan for Cape Canaveral AS includes a burn plan to manage scrub oak. Rare plants and animals can be found in such openings where fire or mechanical removal of trees has occurred (Florida Natural Areas Inventory, 1996b).



EXPLANATION

- 1 — U.S. Highway
- 95 — Interstate Highways
- 405 — State Route
- Cape Canaveral AS

Biological Resource Features, Cape Canaveral AS, Florida

0 1.25 2.5 5 Miles

Figure 3.14-1

EELV/019

Maritime hammock is found on Cape Canaveral AS in two locations: on the east side, just landward of coastal strand, referred to as Atlantic maritime hammock, and on the west side of the peninsula, bordering the Banana River, referred to as Banana River maritime hammock. The largest stand of Atlantic maritime hammock occurs on the southern end of the station. Coastal strand
typically contains sea oats (a state species of special concern) and is often integrated with scrub species from the coastal scrub communities. It often contains thickets of cabbage palm, saw palmetto, sea grapes, and tough buckthorn (Florida Natural Areas Inventory, 1996b).

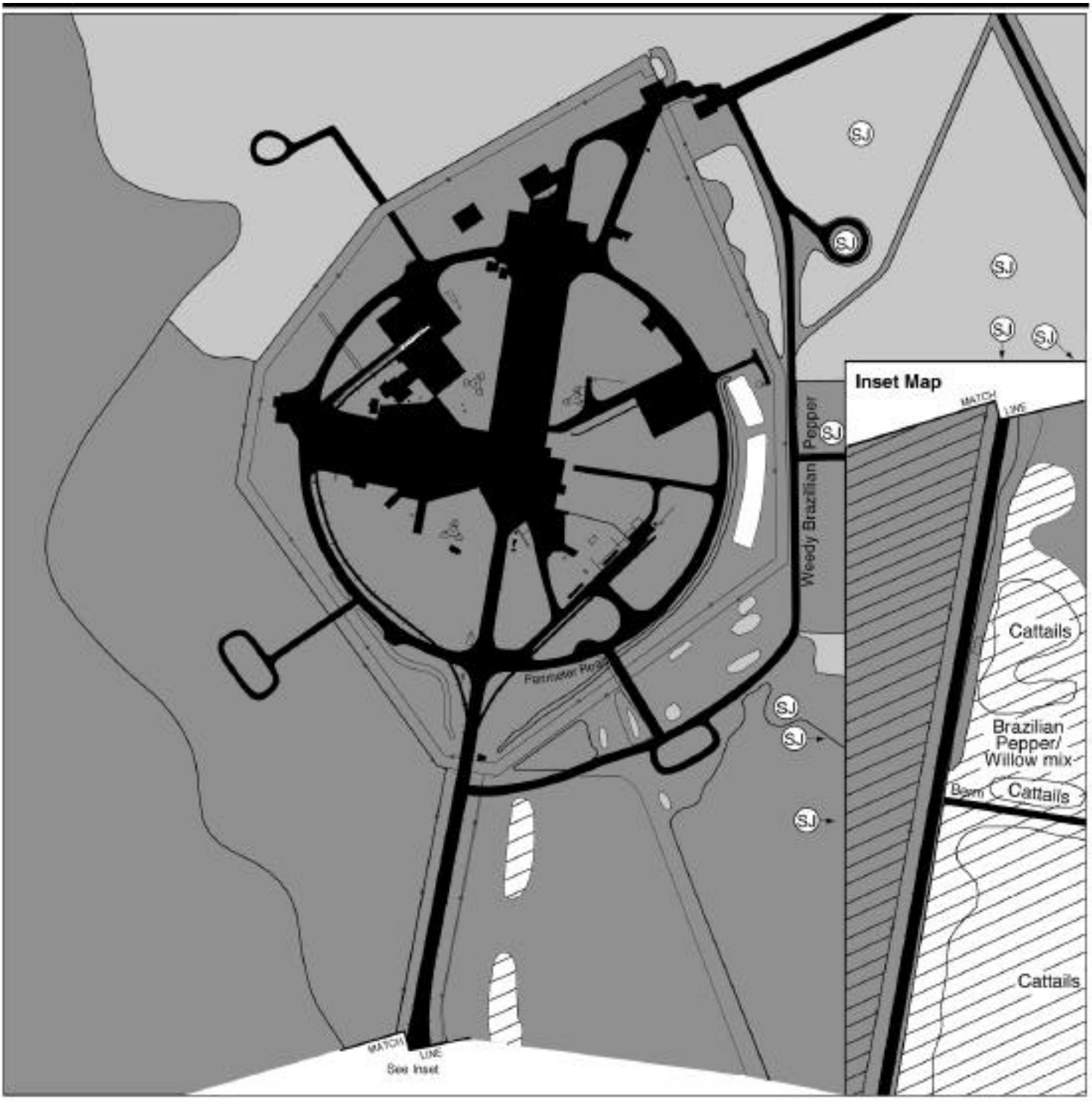
Coastal dunes are inhospitable to many plants because of the constantly shifting substrate, salt deposition, abrasion from wind-blown sand, and effects of storm waves. The beaches south of Cape Canaveral AS have been eroding, while beaches to the north are enlarging. Cape Canaveral AS beaches are also enlarging, and several parallel dune lines and conspicuous offshore sand bars are supported. Sea oats, beach elder, railroad vine, beach croton, bitter panic grass, saltgrass, camphorweed, and beach cordgrass can often be found in coastal dune communities (Florida Natural Areas Inventory, 1996b).

Natural grasslands are rare in the areas of the launch complexes. These areas are subject to frequent disturbance from mowing and other human activities, and grasslands there typically comprise primarily exotic species.

Seagrasses, including Cuban shoal, manatee, and turtle grasses, are present in the northern Indian River system (including the Banana River).

Concept A ROI. Florida coastal scrub is the prevalent vegetation type surrounding SLC-41, although maritime hammock is found adjacent to the southern side of the complex (Figure 3.14-2). Mowed grasses and forbs are the predominant vegetation on SLC-41. Brazilian pepper dominates the Titan II Transporter Road margins, excluding all but the hardiest live oak, red cedar, wax myrtle, and cabbage palm. Woody vines are found entwined in the tree cover and include wild grape, pepper vine, and Virginia creeper. Coastal plain willow and giant leather fern characterize the Brazilian pepper transition into a wetland community, which is described in Section 3.14.1.4. Maritime hammock comprises 1.5 acres on the site and represents the only high-quality natural community on the project site.

Concept B ROI. Florida coastal scrub is the prevalent vegetation type surrounding SLC-37, although maritime hammock is found adjacent to the northern side of the complex (Figure 3.14-3). Scrub habitat is also found along the entrance to SLC-37, although the Brazilian pepper is dominant along the roadways. Portions of SLC-37 within 200 feet of the beach area are within the influence of the coastal strand communities. The proposed HIF site location contains a coastal scrub community with dry grassy swales.



EXPLANATION

- Security Fence
- SJ Scrub Jay territories
- Developed
- Drainage ditch (open water)
- Barren
- Brazilian Pepper
- Maritime Hammock
- Mowed or open grassland
- Oak or Coastal Scrub (FL Scrub Jay habitat)
- Saltwater marsh
- Wetland

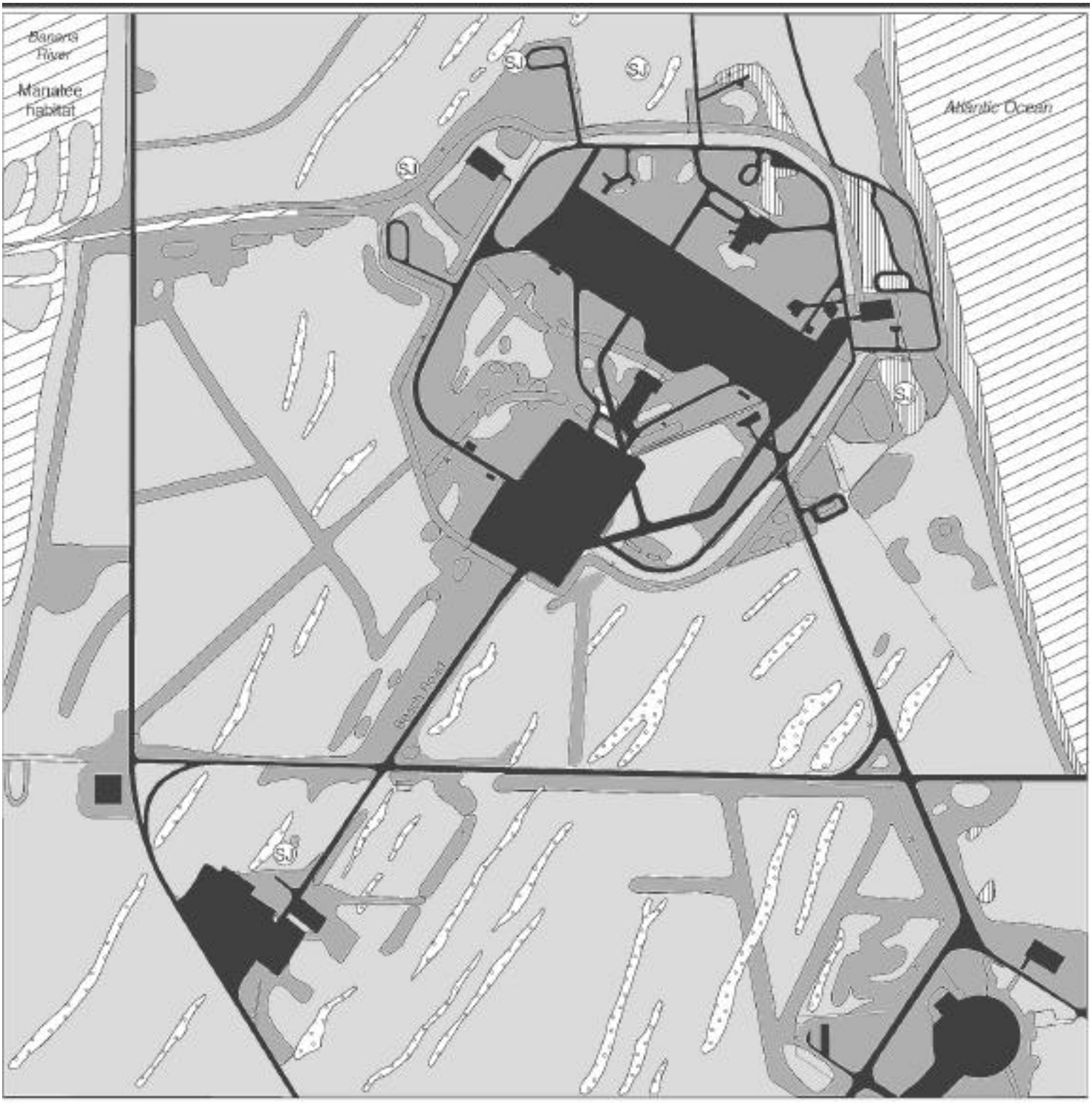
0 150 300 Feet

Source: Aerial photograph, Smith Environmental Services, 1997; Earth Tech, 1997; site visit, 1997.

SLC-41 Vegetation and Sensitive Habitat Cape Canaveral AS, Florida

Figure 3.14-2

EEL/114



EXPLANATION

- HIF — Horizontal Integration Facility
- SJ — FL Scrub Jay territories
- Swale
- Developed
- Open water
- Coastal dune vegetation
- Coastal strand vegetation
- Mowed or open grassland
- Oak or Coastal Scrub (FL Scrub Jay habitat)
- Open sand (Beach mouse habitat)
- Palmettos
- Wetlands/ wet areas

0 200 400 800 Feet

Source: Aerial photograph interpretation following site visit, 1997; Earth Tech, 1997.

SLC-37 Vegetation and Sensitive Habitat Cape Canaveral AS, Florida

Figure 3.14-3

Myrtle oak, sand live oak, Chapman's oak, saw palmetto, sand cordgrass, prickly pear, and buckthorn dominate this vegetation type.

3.14.1.2 Wildlife. The coastal scrub and associated woodlands provide habitat for mammals including the white-tailed deer, armadillo, bobcat, feral hog, raccoon, long-tailed weasel, and round-tailed muskrat. The Florida mouse (a state species of special concern) requires open dry scrub habitat and could occur on Cape Canaveral AS.

Numerous land and shore birds are found at Cape Canaveral AS. In the maritime hammock, the little blue heron, the mourning dove, the gray catbird, the black-throated warbler, and the northern cardinal can be found. Burned hammock provides habitat for the rufous-sided towhee, the common yellow-throat, the northern mockingbird, the house wren, the downy woodpecker, and the osprey. Oak-hickory scrub is habitat for the blue and scrub jays, the mourning and common ground doves, and the red-bellied woodpecker, as well as many maritime hammock species. Shore birds include the black-necked stilt, the willet, the ruddy turnstone, the spotted sandpiper, gulls, the Caspian tern, the brown pelican, the roseate spoonbill, the wood stork, and the great blue heron. Turkey vultures, hawks including the red-tailed and the sharp-shinned hawks, the barn swallow, the fish crow, the common grackle, warblers, and sparrows are also found on Cape Canaveral AS.

Neotropical migrants observed on Cape Canaveral AS include eight species of warbler such as the blue-winged and black-and-white warblers, yellow-throated and red-eyed vireos, the eastern kingbird, the ovenbird, and the American redstart. Migrating raptors, including merlin, Cooper's hawk, and peregrine falcon, forage in the maritime hammock during fall and spring.

Numerous amphibians and reptiles have been observed at Cape Canaveral AS. Amphibians observed include the spade-foot and eastern narrow-mouth toads, squirrel and southern leopard frogs, and green treefrogs. Besides the common American alligator, reptiles observed include the Florida box turtle, the gopher tortoise, the Florida softshell, the green anole, the six-lined racerunner, the broadhead skink, the southern ringneck snake, the everglades racer, the eastern coachwhip, and the mangrove salt marsh snake.

The Cape Canaveral AS area is a transition zone between temperate and subtropical forms in terms of aquatic biota. Aquatic organisms found in the area are generally adapted to fluctuations in temperature and salinity. Numerous marine mammals can be found along the coast of Florida near Cape Canaveral AS and in the lagoons, including the bottlenose dolphin, the spotted dolphin, and the manatee. The seagrass beds in the northern Indian River system provide important nursery areas, shelter, and foraging habitat for a wide variety of fish and invertebrates, and for manatees. The Banana and Indian rivers and the Mosquito Lagoon provide habitat for marine worms, mollusks, and crustaceans. The Mosquito Lagoon, located approximately 6 miles northwest of Cape Canaveral AS, is considered an important shrimp nursery area. It also has the best oyster and clam harvesting in the area.

Within the Indian and Banana River systems, a number of saltwater fish species can be found. The bay anchovy is one of the dominant species inhabiting the lagoon system (U.S. Air Force,1987a). Other species known to occur include pipefish, goby, silver perch, lined sole, spotted seatrout, and oyster toadfish.

The small freshwater habitats found on Cape Canaveral AS contain bluegill, garfish, largemouth bass, killifishes, sailfin molly, and top minnow.

Concept A ROI. Wildlife on SLC-41 is mostly transient. The SLC is mostly developed (urban landscape).

Concept B ROI. Gopher tortoise burrows were found in many areas on SLC-37.

3.14.1.3 Threatened and Endangered Species. Cape Canaveral AS contains habitat utilized by a large number of federally and state-listed species. Listed species that are known to be present or near the station boundaries are presented in Table 3.14-1.

Six species of listed plants have been documented on Cape Canaveral AS (Florida Natural Areas Inventory, 1996b). Two of these species, Curtiss' milkweed (one occurrence) and the nodding pinweed (two occurrences), were identified in scrub habitat on the southern half of Cape Canaveral AS. These species are dependent on the clearings created by occasional fires and benefit from clearing for scrub jay habitat.

Two listed plant species were found in maritime and hydric hammocks: hand fern (one occurrence) and the satin-leaf (not recorded when found). These communities are not fire-maintained and are threatened by the encroachment of exotic species, such as the Brazilian pepper. The hand fern is an epiphyte that exists in cabbage palmetto old leaf bases, which are present in moist hammock communities. It is extremely sensitive to habitat disturbance. The hand fern was found on the southern half of Cape Canaveral AS.

The remaining two listed plant species were also found in coastal dune, coastal interdunal swale, and coastal strand habitats, as well as in openings and disturbances in other communities: beach-star (five occurrences) and coastal vervain (ten occurrences). These species are colonizers of open, sandy areas provided by wind, fire, or storm overwash. The beach-star was found along sandy beaches. The coastal vervain was found along some roads and other areas on the station. None of the populations occurs near the roads or facilities proposed for EELV activities.

Table 3.14-1. Threatened, Endangered, and Candidate Species Occurring or Potentially Occurring at Cape Canaveral AS, Florida

Common Name	Scientific Name	Federal Status	State Status
Plants			
Giant leatherfern	*Acrostichum danaeifolium*	-	T
Curtiss' milkweed	*Asclepias curtissii*	-	E
Satin-leaf	*Chrysophyllum olivaeforme*	-	E
Coastal vervain	*Glandulareia maritima*	(C2)	E
Nodding pinweed	*Lechea cernua*	-	E
Hand fern	*Ophioglossum palmatum*	-	E
Golden polypody	*Phlebodium aurea*	-	T
Beach-star	*Remirea maritima*	-	E
Reptiles and Amphibians			
Gopher frog	*Rana capito*	C	SC
American alligator	*Alligator mississippiensis*	T(S/A)	SC
Eastern Indigo snake	*Drymarchon corais couperi*	T	T
Green sea turtle	*Chelonia mydas*	E	E
Loggerhead sea turtle	*Caretta caretta*	T	T
Leatherback sea turtle	*Dermochelys coriacea*	E	E
Atlantic (Kemp's) Ridley sea turtle	*Lepidochelys kempi*	E	E
Hawksbill sea turtle	*Eretmochelys imbricata imbricata*	E	E
Birds			
Wood stork	*Mycteria americana*	E	E
Bald eagle	*Haliaeetus leucocephalus*	T	T
Peregrine falcon	*Falco peregrinus*	E(S/A)	E
Florida scrub jay	*Aphelocoma coerulescens coerulescens*	T	T
Piping plover	*Charadrius melodus*	T	T
Least tern	*Sterna antillarum*	-	T
Southeastern American kestrel	*Falco sparverius paulus*	(C2)	T
Mammals			
Manatee	*Trichechus manatus*	E	E
Southeastern beach mouse	*Peromyscus polionotus niveiventris*	T	T
Finback whale	*Balaenoptera physalus*	E	E
Humpback whale	*Megaptera novaeangliae*	E	E
Northern right whale	*Eubalaena glacialis*	E	E
Sei whale	*Baeaenoptera borealis*	E	E
Sperm whale	*Physeter catodon*	E	E

C = candidate (former Category C1)
C2 = former Category 2
E = endangered
SC = special concern (state designation)
(S/A) = listed by similarity of appearance to a listed species
T = threatened

Listed animals in the vicinity of the launch complexes include the bald eagle, the southeastern American kestrel, the American alligator, the Atlantic loggerhead and green sea turtles along the Atlantic coastline; the southeastern beach mouse along the vegetation zones paralleling the beach

and dune lines; the eastern indigo snake and the gopher frog in moist areas or in dry land gopher tortoise burrows; gopher tortoises in all habitats; the Florida scrub jay in Florida coastal scrub and slash pine stands; and the West Indian manatee along the Banana River (National Aeronautics and Space Administration, 1996).

The gopher tortoise is still common in some parts of its range although rare in others. Although this species is not formally listed by federal or state agencies, gopher tortoise habitat warrants special note because the burrows provide important habitat to numerous other protected species. The gopher tortoise was found in moderate densities on Cape Canaveral AS in areas of sandy, well-drained soils, primarily in coastal strand and dry clearings. The gopher tortoise prefers open habitats that have herbaceous plants for forage including disturbed areas such as recent burn areas, road shoulders, fence lines, and launch complexes. Gopher tortoises are tolerant of human presence.

The gopher frog is a candidate species found mainly in native xeric upland habitats, including xeric oak hammocks. It will often use gopher tortoise burrows as shelter. The egg masses are often laid within 4.5 centimeters of the water's surface on emergent vegetation or on the bottom of shallow pools.

Although commonly found throughout Cape Canaveral AS, the American alligator is federally listed as threatened because it is similar in appearance to the American crocodile, which is not present on the station. The American alligator lives in fresh to brackish waters found in marshes, ponds, lakes, rivers, swamps, bayous, and large spring runs. It basks on land next to the water and digs dens and builds nests in river banks, lake margins, or marshes. The American alligator uses the dens for protection from cold or drought.

The threatened eastern Indigo snake has been found on Cape Canaveral AS and likely occurs throughout the station. It is known to occur in most types of hammocks, flatwoods, scrub, and swale marshes, often near wetlands, and is often associated with gopher tortoise burrows. Home ranges for males range from 191 to 360 acres; female home ranges are from 14 to 139 acres.

Green sea turtle breeding populations along the Florida and Pacific coasts and the Gulf Coast of Mexico are federally listed as endangered; all other populations are listed as threatened throughout its range worldwide. Pollution and human development are degrading the beach nesting and ocean feeding habitats for the green sea turtle in portions of its range. Nighttime lighting near beaches generally makes nesting on beaches unsuitable for successful reproduction. Development on the beaches sometimes forces nesting to occur too close to the tidal zone, which causes many nests to be destroyed by tidal inundation and erosion. Green sea turtles are present on the Florida coast from May to October (Mercadante, 1997) and are known to nest on Cape Canaveral AS beaches. Cape Canaveral AS has a lighting management program in place to minimize light impacts on sea turtle nesting beaches.

The threatened (federal and state listing) loggerhead sea turtle is relatively abundant and occupies most of the Florida coastline. The turtles nest on the beaches of Florida from May to October. It is possible that only the females are migratory; males are known to occupy Florida waters year-round. Loggerhead sea turtles are known to nest on Cape Canaveral AS beaches.

The endangered (federal and state listing) leatherback sea turtle population in Florida is small and is threatened by disturbances to natural lighting conditions, erosion, nest predation, and pollution along the beaches. Leatherback sea turtles occur mainly in the open sea, but some females can be found on the Florida beaches and utilize coastal waters from April to July. The leatherback sea turtle has been reported to nest on Cape Canaveral AS beaches (three occasions).

Although the Atlantic (Kemp's) Ridley and the Hawksbill sea turtles are not known to nest on Cape Canaveral AS beaches, they have been known to occur in the waters off the Florida coast and near shore areas.

Wood storks forage in marshes, ponds, and lagoons and are year-round residents in the Cape Canaveral AS area, nesting in the treetops of mangrove swamps or by man-made impoundments.

As of 1995, the bald eagle has been down-listed to threatened throughout the continental United States, although the Florida population has been listed as threatened for years. They can be found year-round near the coast, rivers, and large lakes of Florida, but they do not breed on Cape Canaveral AS, although numerous active nests have been reported at the KSC. On rare occasions, bald eagles can be tolerant of human activity if it is not directed toward them. However, they typically need a one-quarter to one-half mile buffer between human activity and an active nest site to avoid disruption of breeding and nesting activities.

All free-flying peregrine falcons are federally listed as endangered (because of their similarity in appearance to the subspecies *Falco peregrinus anatum,* which is listed as endangered). The peregrine falcon migrates through the Florida area and can be found most of the year, except from mid-June to mid-August. The bird is basically tolerant of human presence.
The Florida scrub jay is a year-round resident that is very sedentary and territorial. Its habitat is in open oak scrub without a dense canopy, as well as palmetto, sand pine, and rosemary. Scrub jays nest in territories adjacent to several northern SLCs with successful nesting occurring March through June next to these launch facilities. As little as 5 to 10 acres of suitable habitat may support a mated pair (Fernald and Toland, 1991). Statewide average scrub jay territory size is 20 acres (U.S. Air Force, 1993b). The average on Cape Canaveral AS is approximately 13 acres. Without suitable habitat, scrub jays are susceptible to predation and have low nesting success. It is believed that 25 percent of the state's total scrub jay population inhabits Cape Canaveral AS. Drier, more sparsely vegetated habitats are better for scrub jay management activities than wetter areas. The species can become habituated to human presence over time. The scrub jays near SLC-40 and SLC-41 were monitored for three years during Titan IVB launches (Larson et al., 1993). Launches occurred every three months from March to September at SLC-40, and once during June at SLC-41. No scrub jay mortalities were

associated with these launches. The only distress shown by any birds within hours of a launch occurred when vegetation was burned or defoliated near a flame trench at SLC-40. The birds avoided this damaged area for one month. A study of the effects of construction on scrub jay territory size found that construction at SLC-41, resulting in a loss of 2.5 acres of scrub and 1.5 acres of mowed grass habitat, caused the average surrounding territories to decrease slightly in size (Larson, et al., 1993).

Least terns nest along sandy or gravelly beaches by SLC-46 and on gravel rooftops in an industrial area on Cape Canaveral AS, approximately 1 mile north of the jetty. They are very sensitive to disturbance when nesting. Inhabiting Cape Canaveral AS from April to mid-October, they typically nest between May and June.

Piping plover nest in or near least tern colonies along the Atlantic coast from approximately March to August. There are no confirmed nesting areas on Cape Canaveral AS; however, they may overwinter in the area.

The Florida populations of the southeastern American kestrel may be year-round residents and were observed in the winter on Cape Canaveral AS. Found in open or partly open habitat in scrub, open forests, cultivated lands, and wooded streams, they have not been observed to breed on Cape Canaveral AS.

The Florida manatee is endemic in this region of Florida, occupying shallow coastal waters, estuaries, bays, and enters coastal rivers and lakes. Sheltered bays, coves, and canals are important environments for its reproductive activities. Manatees are semipermanent residents in the area but may migrate southward for the winter. Manatee critical habitat is present in the Banana River on Cape Canaveral AS and in the surrounding area (see Figure 3.14-1). Manatees are sensitive to human disturbance, and their survival is complicated by their low population densities, low reproductive rates, limited range, and high mortalities. Die-offs associated with red tides and unusually cold weather have occurred in Florida. However, the primary threat to the manatee is boat-propeller-inflicted injury.

Southeastern beach mouse populations on Cape Canaveral AS have been found at the launch complexes where the area is artificially open grassland. The coastal grasslands and strand communities provide the highest population densities at Cape Canaveral AS. Other habitat is the primary dune, although the sea oat vegetation is not as suitable for the beach mouse as the grassland.

Finback, humpback, northern right, sei, and sperm whales, all federally and state-listed as endangered, are pelagic mammals that are generally found from the shelf edge seaward. The whales move to northern temperate waters in the spring and toward the equator in the fall, migrating past Cape Canaveral AS and around the tip of Florida north of Cuba. The National Marine Fisheries Service (NMFS) is proposing to designate the water adjacent to the coast of Florida as critical habitat for the northern right whale.

Concept A ROI. Scrub jay nesting territories are adjacent to the eastern side of SLC-41 and are approximately 500 feet east of the site of the two proposed assembly facilities (see Figure 4.13-2). Although no sensitive species are known to reside on SLC-41, many sensitive species such as the manatee occur in the adjacent aquatic habitat. At the site of the proposed assembly facilities, two plants listed as threatened by the Florida Department of Agriculture and Consumer Services occur: the giant leather fern and the golden polypody. These plants are locally abundant, however, and are not listed as rare on Cape Canaveral AS by the Florida Natural Areas Inventory (Smith Environmental Services, 1997). One American alligator was documented as using the cattail marshes and adjacent Brazilian pepper/willow wetland on the assembly facilities site, but this species is common on Cape Canaveral AS.

Concept B ROI. The gopher tortoise occurs on SLC-37 and could support numerous commensal species. The complex is also adjacent to Florida beach mouse habitat. Scrub jay nesting territories are adjacent to SLC-37, and scrub jays use the open habitat on the SLC for foraging. Scrub jay nesting territories are also present at the proposed HIF site.

3.14.1.4 Sensitive Habitats. Sensitive habitats on Cape Canaveral AS include wetlands, critical habitats for threatened and endangered species as defined by the Endangered Species Act, and the nearby Cape Canaveral National Seashore and Merritt Island National Wildlife Refuge.

Wetlands. Cape Canaveral AS contains many wetlands and associated vegetation communities including estuarine tidal (mangrove) swamps and marshes, hydric hammock, coastal interdunal swales, and man-made borrow pits and canals. A U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory conducted in 1994 identified a total of 2,235 acres of wetlands on Cape Canaveral AS. Specific wetland delineations for each concept have been conducted and are described in the site-specific discussions that follow.

Hydric hammocks occur along the Banana River on the western boundary of the station in lowland areas where the soils are generally saturated year-round but are inundated only for short periods after heavy rains. Hydric hammocks often transition into a sawgrass-willow or cattail marsh. Cabbage palm is present throughout the hammock, and live oak, American elm, and mulberry are present in the better-drained areas. Tropical species including the myrsine, twinberry, wild coffee, and white stopper can be found with strangler fig “strangling” cabbage palms. Ferns are abundant in many areas. The exotic Brazilian pepper has invaded even the most intact hydric hammock.

Coastal interdunal swales are found in the coastal dune areas and between areas of maritime hammock. These swales are saturated most of the year and support grasses and a few woody plants. Sedges, arrowhead, frog-fruit, sabatia, and fleabane can also be found. The drier swales support some woody plants including the wax myrtle, the live oak, the saw palmetto, and the groundsel tree. The listed coastal vervain can be found in the interdunal swales.

Cape Canaveral National Seashore. The Cape Canaveral National Seashore lies north of Cape Canaveral AS (see Figure 3.14-1). The least disturbed and undeveloped coastal segments remaining along Florida's eastern shoreline were set aside in 1975 as part of the National Seashore to ensure preservation of these segments.

Merritt Island National Wildlife Refuge. The Merritt Island National Wildlife Refuge lies west of Cape Canaveral AS (see Figure 3.14-1). A large manatee aggregation site, attracting up to 200 manatees in the spring, is within the boundaries of the refuge. Other threatened or endangered species that inhabit the scrubby flatwoods of Merritt Island include the Florida scrub jay, the eastern indigo snake, and the southern bald eagle.

Critical Habitat. Manatee critical habitat, located in the Banana River system, includes the entire inland sections of the Indian and Banana rivers, and all waterways between the two rivers, with the exception of some man-made structures or impoundments not necessary to the normal needs of the manatee. The NMFS is proposing to designate the water adjacent to the coast of Florida as critical habitat for the northern right whale.

Indian River Lagoon. The Indian River Lagoon is home to more than 4,300 kinds of plants and animals. This unique estuary is actually three lagoons, the Mosquito Lagoon, the Banana River, and the Indian River (Pacetti, 1996). These "rivers" have no mouth or flowing current but are headwaters where flow begins, fed by rivers, canals, and streams. The lagoon has a gradation of brackish water (salt and fresh water mixed) to salt water where it opens to the ocean. This lagoon, which is listed as an Estuary of National Significance, contains more species than any other estuary in North America (2,965 animals, 1,350 plants, 700 fish, and 310 birds) (St. John's River Water Management District, n.d.). Located along the Atlantic Flyway, it provides important migratory bird habitat. The lagoon contains one of the highest densities of nesting turtles in the western hemisphere (Pacetti, 1996), is a rich fishery, and is used by up to one third of the United States' manatee population. Development along the shoreline and mosquito control practices have destroyed large areas of mangroves and seagrasses. Mangroves provide essential shoreline protection and nesting areas for rare lagoon birds, such as the wood stork and the roseate spoonbill.

The upper reaches of the Banana River adjacent to Cape Canaveral AS and the lower reaches of the Mosquito Lagoon have generally good water quality due to the lack of urban and industrial development in the area. However, as summarized in the water quality discussion, phenols and aluminum (found in liquid rocket fuels) and pH (a result of solid rocket fuel combustion) occasionally exceed state water quality criteria in these areas. Localized fish kills have been noted after space shuttle launches as a direct result of a temporary (several hours) and localized increase in acidity in the waters adjacent to the launch sites. The long-term effects that these pollutants will have on the estuaries of the area is unknown.

Concept A ROI. Wetlands near SLC-41 consist mainly of mixed salt-tolerant grasses, black mangroves, and sea oxeye daisy vegetation (National Aeronautics and Space Administration, 1995c). The mangrove swamps occur in a mosaic fashion on the northwestern edge of Cape Canaveral AS as it

fringes the Banana River. A wetland delineation was conducted for the proposed assembly facilities site. Approximately 8.2 acres of the total 13.5-acre site are jurisdictional wetlands (Smith Environmental Services, 1997). These wetlands are isolated and extremely degraded. Exotic and nuisance plant species, primarily Brazilian pepper, coastal plain willows, and cattail, replaced the historical saltmarsh/mangrove plant communities after mosquito control and development in the area completely isolated the wetlands from the Banana River Lagoon. The disturbance created a wetland with extremely low natural community heterogeneity habitable by only a narrow range of fish and wildlife.

East of the access road to SLC-41, several areas have been impounded and flooded for mosquito abatement. These impounded areas are considered wetlands, although they are not of high quality.

A wood stork rookery was located approximately 1.4 miles north of SLC-41 (National Aeronautics and Space Administration, 1995c). This rookery was abandoned in 1991.

Concept B ROI. A wetland delineation was conducted from May to August 1997 (ENSR Corporation, 1997c). SLC-37 contains approximately 7 acres of drainage that are not protected as wetlands because they were constructed on dry land, but may be considered “other surface waters” by the SJRWMD and “Water of the United States” by the USACE (see Figure 3.14-3). The vegetation in these ditches consists of Brazilian pepper, wax myrtle, cattail, duckweed species, leather fern, and water primrose.

SLC-37 is also surrounded by an upland ditch that ultimately connects to the Banana River to the west. This wetland contains cattail and water primrose.

Wetlands were also delineated at the proposed HIF site. Two small, isolated swales of approximately 0.31 and 0.37 acre are on the site (see Figure 3.14-3). They contain sawgrass, sand cordgrass, climbing hempvine, marsh fleabane, wax myrtle, and saltbush. These wetlands have been impacted by changes in the natural hydrology and do not maintain a high functional value (ENSR Corporation, 1997c).

3.14.2 Vandenberg AFB

The ROI for biological resources consists of Vandenberg AFB, the adjacent Pacific Ocean, and the northern Channel Islands (Figure 3.14-4).

3.14.2.1 Vegetation. Vandenberg AFB occupies a transition zone between the cool, moist conditions of northern California and the semi-desert conditions of southern California. Many plant species and plant communities reach their southern or northern limits in this area. Natural vegetation types on Vandenberg AFB include southern foredunes; southern coastal, central dune, central coastal, and Venturan coastal sage scrub; chaparral including central maritime chaparral; coast live oak woodland and savanna; grassland; tanbark oak and southern bishop pine forest; and wetland communities including coastal salt marsh and freshwater marsh, riparian forests, scrub, and vernal pools (U.S. Air Force, 1989a).

Under the No-Action Alternative, Atlas IIA, Delta II, and Titan IVB launches would continue from SLC-3E, SLC-2W, and SLC-4E, respectively. Within this section, the descriptions of SLC-3E and SLC-4E are included within the Concept A and B ROI descriptions. Because SLC-2W is located on North Vandenberg AFB, the ROI for this site is described separately within each subsection. The undeveloped areas of SLC-2W contain sparse vegetation that can be described as coastal dune scrub. Central dune scrub has been defined by Holland (1986) as a "dense coastal scrub community of scattered shrubs, subshrubs, and herbs generally less than one meter tall and often

EXPLANATION

- Base Boundary
- SLC — Space Launch Complex
- (246) — State Route
- Marine Ecological Reserve

0 .5 1 2 Miles

Biological Resource Features, Vandenberg AFB, California

Figure 3.14-4

EELV/106

developing considerable cover." This plant community is characterized by species suited to central California's coastal dune environments, such as mock heather, dune lupine, California sage brush, deerweed, and dune mint. Dune mint is a federally listed Category 2 species and is on California Native Plant Society List 1B (plants rare and endangered in California and elsewhere) (National Aeronautics and Space Administration, 1993).

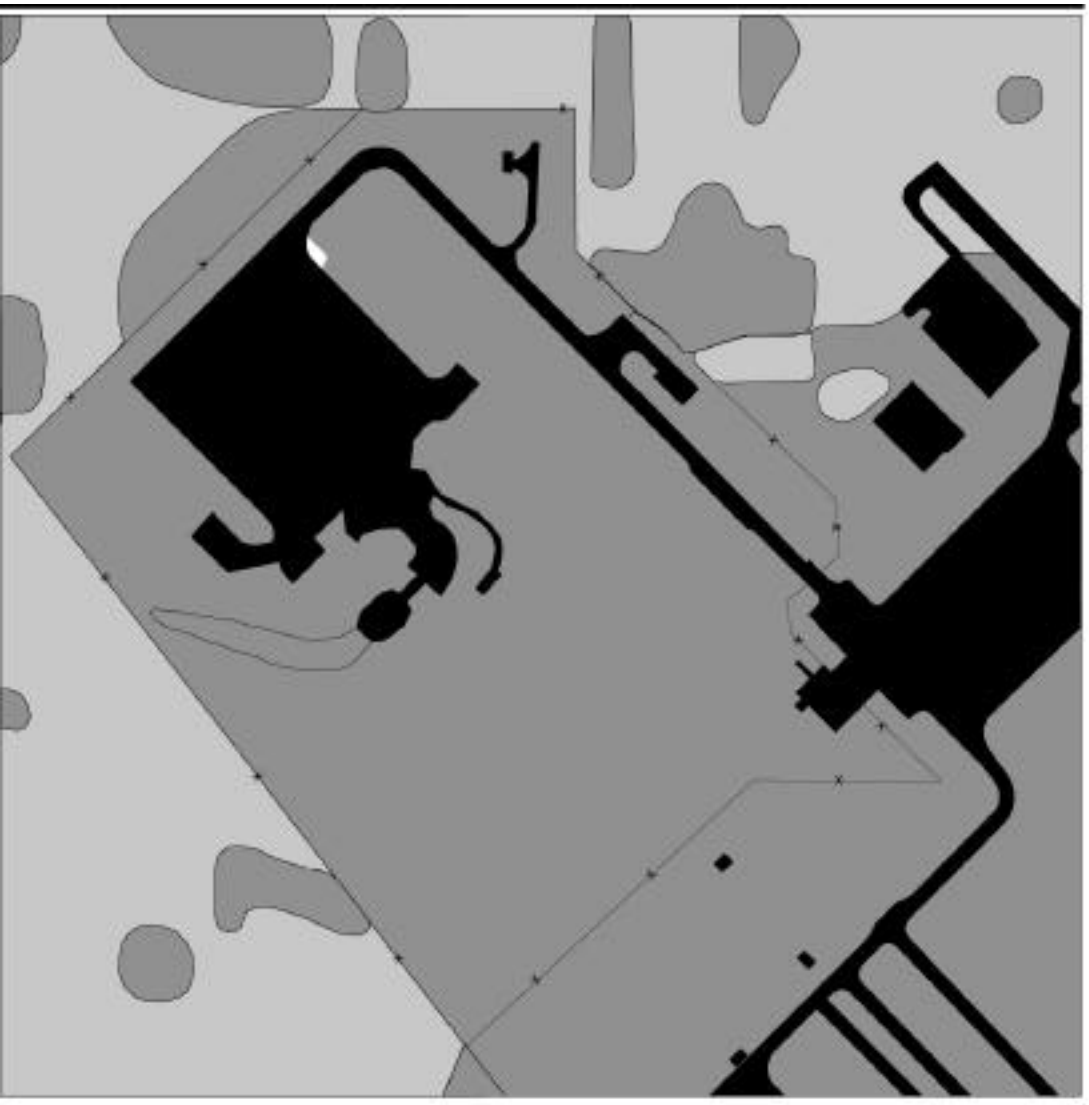
Concept A ROI. Plant communities in the vicinity of SLC-3 include coastal sage scrub, grassland and disturbed areas, mixed grassland-coastal sage scrub, riparian woodland and associated emergent vegetation, Burton Mesa chaparral (central maritime chaparral), and non-native woodland (Figure 3.14-5) (U.S. Air Force, 1991f). The coastal sage scrub community is dominated by California sagebrush, coyote brush, mock heather, poison oak, Lompoc bush monkeyflower, and giant wild rye. Two former Category 2 species, black-flowered figwort and Kellogg's horkelia, occur in the coastal sage scrub community and are known to occur near SLC-3 (U.S. Air Force, 1991f).

The grassland community is dominated by non-native grasses including brome, veldtgrass, wild oats, and fescue. It may also include native perennial needle grasses and scattered small shrubs, such as cudweed aster and California sagebrush. Native and non-native forbs associated with the grassland include lupine, owl's clover, blue-eyed grass, and tomcat clover. This plant community occurs on disturbed sites. More substantially disturbed areas, such as SLC-3, are dominated by veldtgrass, black mustard, filaree, hottentot fig, and California goosefoot. Mowed weedy areas occur within the SLC-3 security fence and along road shoulders (U.S. Air Force, 1991f).

The mixed grassland-coastal sage scrub community is a transitional area between grassland, the primary plant community in disturbed areas, and coastal sage scrub, which is the next successional stage in plant community development. The area contains a mosaic of grassland and coastal sage scrub (U.S. Air Force, 1991f).

A riparian woodland community dominated by willows is adjacent to SLC-3 along Bear Creek and associated spring and seeps in tributary canyons, and in a small drainage ditch at the foot of the SLC-3W retention basin. In places, the riparian woodland plant community contains a dense understory of twinberry, blackberry, stinging nettle, and poison oak (U.S. Air Force, 1991f).

Burton Mesa chaparral near SLC-3 is characterized by dense shrubs such as Santa Cruz Island oak, chamise, coast ceanothus, Santa Barbara ceanothus, Purisima manzanita, shagbark or sand mesa manzanita, and Lompoc bush monkeyflower. A number of perennial and annual herbaceous plants also occurs in the Burton Mesa chaparral community. Species composition and vegetative cover vary among sites dependent on the shrub density. Several



EXPLANATION

- Coastal Sage Scrub
- Barren
- Developed
- Electrical line
- Grasslands
- Wetland (Willow Riparian)

0 60 120 240 Feet

Source: Bionetics Corporation, 1998; site visit, 1997

SLC-3W Vegetation and Sensitive Habitat Vandenberg AFB, California

Figure 3.14-5

EELV15

of the shrubs found in Burton Mesa chaparral are local endemics, including the shagbark manzanita and the coast and Santa Barbara ceanothus (U.S. Air Force, 1991f). Blochman's or dune delphinium is a former Category 2 species that has been found in coastal chaparral on South Vandenberg AFB (Oyler et al., 1995).

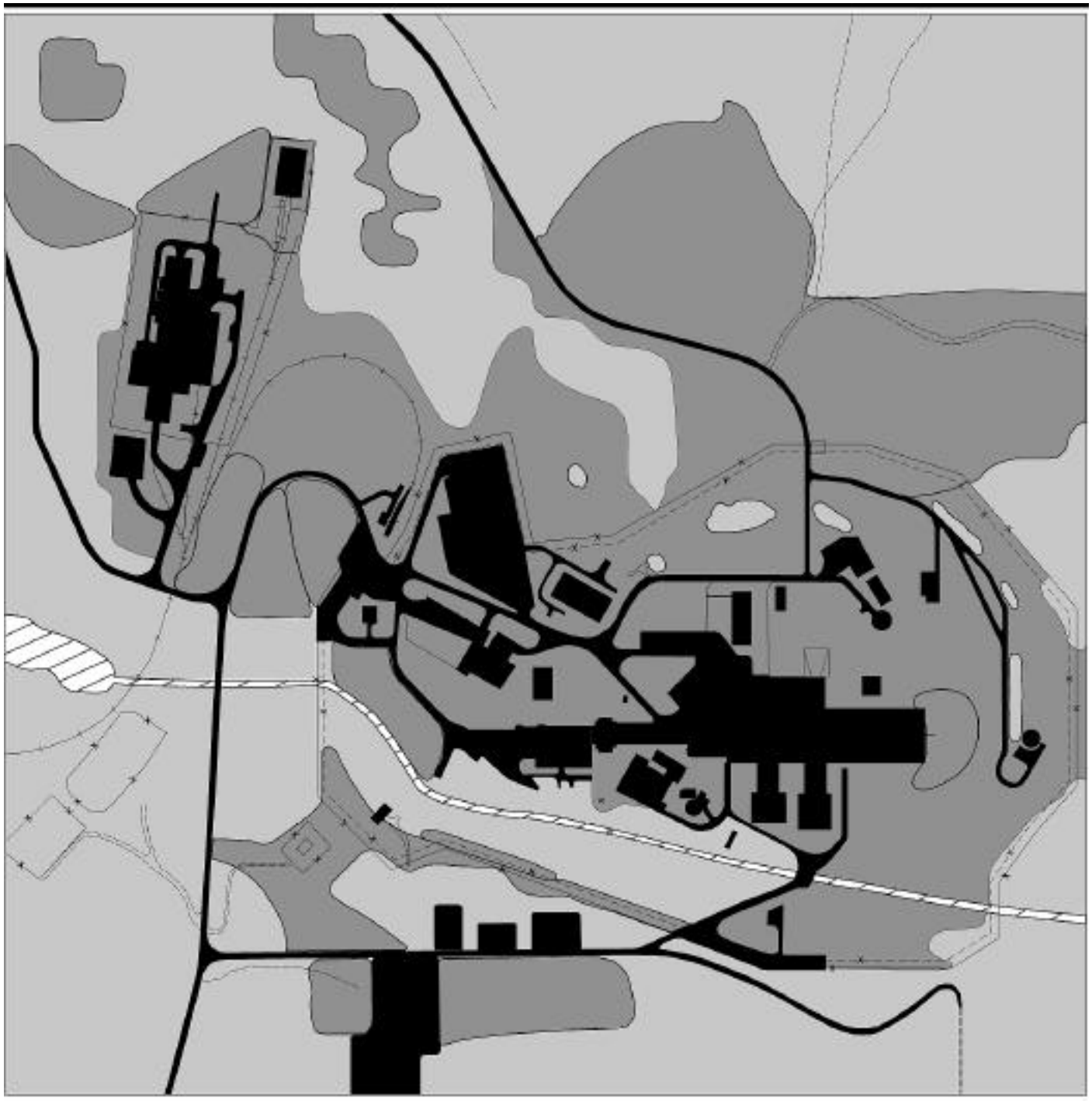
Several non-native woodlands occur near SLC-3, the most common of which are tall, often monotypic stands of planted blue eucalyptus. Two stands occur near SLC-3 adjacent to Bear Creek. The blue eucalyptus leaf litter contains toxins that prevent germination of many plants. Planted stands of Monterey cypress also occur along Bear Creek. The edges of woodlands and clearings contain a sparse herbaceous cover dominated by wild oats, black mustard, and veldtgrass (U.S. Air Force, 1991f).

A survey of SLC-3W, associated intersections requiring modifications, and the disturbance at the Upper Stage/Processing Facility and Building 7525 was conducted (Fugro West, Inc., 1996). The vegetation in these areas is dominated by non-native plants such as hottentot fig, veldtgrass, filaree, plantain, and ripgut grass. The most common native species in areas less disturbed include California sagebrush, heather goldenbush, California buckwheat, common cudweed aster, and dune lupine.

Concept B ROI. Plant communities in the vicinity of SLC-6 include central coastal sage scrub, chaparral including maritime chaparral, grassland, riparian wetlands, eucalyptus (non-native woodlands), and ruderal areas (Figure 3.14-6). Ruderal vegetation is characterized by disturbance-tolerant, mostly non-native species, primarily introduced grasses such as brome, veldtgrass, wild oats, and fescues. In addition to these plant communities, north-facing slopes dominated by monkeyflower, coyote bush, and California sagebrush with Indian paintbrush, fern, miner's lettuce, and dudleya in the understory are located south of SLC-6. These represent a residual north-coastal flora comprising species more widespread 10,000 years ago during a cooler, moister period (U.S. Air Force, 1978).

Crisp and San Luis Obispo monardellas are two former Category 2 species found in sandy areas. Both have been reported to be present near SLC-6 (Oyler et al., 1995).

The boathouse area is dominated by non-native grassland with scattered coyote brush, California sagebrush, goldenbush, and herbs including vetch and locoweed. The area has been subject to cattle grazing for at least the past 60 years (U.S. Air Force, 1989a). Coastal strand occurs along Vandenberg AFB's beaches. Native beach plants include beach saltbush, sea rocket, sand verbena, beach morning-glory, and beach burr. European beachgrass and ice plant, non-native species, are pervasive and spreading on most Vandenberg AFB beaches (Persons and Applegate, 1996).



EXPLANATION

- Double Fence (If required)
- Security Fence
- HIF — Horizontal Integration Facility
- Developed
- Barren
- Coastal Sage Scrub
- Grassland
- Wetland

0 145 290 580 Feet

Source: Bionetics Corporation, 1988; site visit, 1997.

SLC-6 Vegetation and Sensitive Habitat Vandenberg AFB, California

Figure 3.14-6

EELV/113

The Boathouse Embayment includes three types of subtidal habitats. A rocky boulderfield covers the shoreward half of the bay, and a sandy bottom habitat occurs in the outer portion. The caissons, pilings, and riprap are the third habitat type in the bay. Dense algal growths cover much of the rocky substrate habitat within the embayment. These consist primarily of red algae, several species of brown algae, and two species of green algae. Surfgrass is also common (U.S. Air Force, 1978).

3.14.2.2 Wildlife. Vandenberg AFB contains a number of habitat types, which support a rich diversity of wildlife. Mammals, numerous species of birds, amphibians, and reptiles are present in adundance on the base. The coastline, nearshore waters, and Channel Islands also support a wide variety of aquatic life, including marine mammals and birds, fish, and invertebrates. Many of these species are Category 2 species, proposed for listing, or regionally rare.

A large number of rodent species occurs in all habitats, with many occurring in more than one plant community. Small carnivores include raccoons, long-tailed weasels, and striped skunks. Feral pigs forage in riparian zones, and mule deer are found in several habitat types. The larger, contiguous, relatively undisturbed tracts of vegetation on South Vandenberg AFB provide high-quality habitat for wide-ranging carnivores including a number of wildlife species recorded as declining in Santa Barbara County. These include the badger, a regionally rare mammal known to occur in coastal sage scrub and grasslands, and the mountain lion, another regionally rare mammal expected to occur in chaparral and riparian woodlands. Other carnivores include the bobcat, the black bear, the gray fox, and the coyote (U.S. Air Force, 1991f).

Amphibians such as ensatina, blackbelly slender salamander, and Pacific treefrogs may occur in coastal sage and chaparral communities and are also found, along with western toads, in riparian woodland areas. Reptiles such as western skink, western fence lizards, southern alligator lizards, and gopher snakes are found in several habitat types. The southwestern pond turtle is a former Category 2 species found on South Vandenberg AFB in Cañada Honda and Jalama creeks. Bear Creek does not support any deeper pool habitats that are essential for the survival of the turtle (U.S. Air Force, 1991f). The two-striped garter snake is also a former Category 2 species found in Cañada Honda Creek. The California horned lizard and the California legless lizard are former Category 2 species found on South Vandenberg AFB (Christopher, 1996a,b).

Several sensitive species may forage on coastal sage scrub and chaparral habitats. These include the northern harrier, the merlin, and the short-eared owl (all special concern species); the white-tailed kite and the tree swallow (both regionally rare); the Cooper's hawk and the prairie falcon (both special concern species and regionally rare); and the ferruginous hawk (former Category 2 and special concern species) (U.S. Air Force, 1991f).
Bell's sage is a former Category 2 and special concern species found in open Burton Mesa chaparral. A population has been identified at a location east of Lompoc Canyon, approximately 2 miles inland.

Three regionally rare and declining bird species (the Swainson's thrush, the warbling vireo, and the Wilson's warbler) nest in the Bear Creek riparian woodland. The Cooper's hawk (a special concern and regionally rare species) may also nest along Bear Creek. Both riparian woodland and non-native planted tree groves attract migrating flycatchers, kinglets, vireos, warblers, sparrows, and orioles. Several species of hawks, owls, and other common raptors roost and nest in the planted non-native tree groves (U.S. Air Force, 1991f).

Burrowing owls (former Category 2 and special concern species) prefer dry, open, grassy, usually treeless plains, occasionally with gently rolling hills. This species utilizes the same habitat for breeding and wintering. Although suitable habitat occurs on Vandenberg AFB, it appears that this species no longer nests there and is now only an uncommon-to-rare winter visitor to grassland and open scrub habitats. California horned larks (former Category 2 and special concern species) breed in grasslands in the Sudden Flats area (U.S. Air Force, 1994c). Loggerhead shrikes (former Category 2 and special concern species) prefer open country with lookout posts, scattered trees, and low scrub vegetation, and have been observed on South Vandenberg AFB (U.S. Air Force, 1994c). The grasshopper sparrow is a regionally rare bird that may forage in grasslands near SLC-6 (U.S. Air Force, 1989a).

The Santa Barbara Channel is located along the Pacific Flyway, at a biogeographical boundary between warm southern and cold northern ocean waters. As a result, an abundance and diversity of marine birds is found along the offshore waters and Channel Islands. As many as 30 species of seabirds are known to occur in the open ocean water of the continental shelf. The elegant tern (former Category 2 and special concern species) is a coastal area post-breeding visitor during late summer and early fall (U.S. Air Force, 1991f). Long-billed curlews (former Category 3 and special concern species) typically winter in coastal areas and are found at South Vandenberg AFB.

The Channel Islands are inhabited by breeding colonies of marine birds, with the largest colonies on San Miguel Island. These include Leach's and ashy storm-petrels; Brandt's, double-crested, and pelagic cormorants; pigeon guillemots; and Cassin's auklets. California's only nesting colony of brown pelicans occurs on Anacapa Island and an islet adjacent to Santa Cruz Island (U.S. Air Force, 1992b). Nesting sites for some of these species are also documented to exist on the mainland. These include Point Pedernales, Destroyer Rock, Point Arguello, Rocky Point, and Point Conception (see Figure 3.14-4) (U.S. Air Force, 1991f).

California sea lions and northern fur, northern elephant, and harbor seals use the northern Channel Islands as haul-out (resting), mating, and pupping areas. The largest concentrations occur on San Miguel Island. Harbor seals haul out at a total of 19 sites between Point Sal and Jalama Beach. Purisima Point and Rocky Point are the primary haul-out sites on Vandenberg AFB. California sea lions do not breed on Vandenberg AFB. However, Point Sal is used heavily as a haul-out site. San Miguel and San Nicolas islands are the major rookeries for California sea lions and northern elephant seals. Northern elephant seals are periodically observed on Vandenberg AFB. Effects to marine mammals have been monitored over several years from Vandenberg AFB launches and are described in Chapter 4.

Small-toothed whales including bottlenose, common and Pacific white-sided dolphins, and killer whales are common near Vandenberg AFB and in the Channel Islands. The gray whale (a former federally listed endangered species, now designated as recovered) is found close to shore off South Vandenberg AFB during migration from Baja, California, to the Bering Sea, between December and May and returns to Baja in November and December (U.S. Air Force, 1991f). Minke whales have been reported within a few miles of the leeward sides of San Miguel, Santa Rosa, Santa Cruz, and Anacapa islands.

A request, under Section 101(a)(5)(A) of the Marine Mammal Protection Act of 1972, as amended, for a letter of authorization for the incidental take of marine mammals during programmatic operations at Vandenberg AFB was submitted to the NMFS in July 1997 (Appendix H). If approved, Vandenberg AFB will be allowed incidental take for up to 20 space launches per year for the next 5 years.

Wildlife in the vicinity of SLC-2W consists of common regional animals as well as those species found in coastal environments. More common wildlife that may occur at SLC-2W include mule deer, jackrabbits, cottontails, and predatory animals such as the bobcat and the coyote. A high diversity of bird species may occur at SLC-2W.

Concept A ROI. Coyote and California ground squirrel burrows were observed throughout the site. Numerous birds observed foraging on site included the Northern harrier, the red-shouldered hawk, the red-tailed hawk, the American kestrel, the Anna's hummingbird, and the California towhee. The regionally rare mountain lion is expected to occur in the chaparral and riparian woodlands near SLC-3W.

Concept B ROI. Burrowing owls have been sighted near the boathouse area (Holmgren and Collins, 1995). Animals of the exposed rocky intertidal area in the Boathouse Embayment include the California mussel; the Pacific goose barnacle; and the common, purple, and ocher seastars. Abalone are also found in this area. Biological diversity within the embayment is highest in the rocky boulderfield habitat, which includes 12 species of benthic invertebrates, the most abundant being the snail *Mitrella carinata* and the seastar *Patiria miniata*. Subtidal sandy bottom surfaces within the embayment contain many benthic and infaunal invertebrates beneath the surface. Two polychaete worms, the burrowing shrimp and the clam *Tellina modesta*, are the most abundant. At least 297 species of fish occur in the Point Arguello region. Many of these pass through the mouth of the embayment. These consist mainly of inshore schooling species such as walleye surfperch, topsmelt, and pile surfperch (U.S. Air Force, 1978). Sea otters, seals, and sea lions also use the waters off Point Arguello.

3.14.2.3 Threatened and Endangered Species. A number of threatened and endangered species is known or expected to occur on Vandenberg AFB and in the adjacent offshore waters. Table 3.14-2 lists all of the federally and state-listed threatened and endangered species, species proposed for federal listing as threatened or endangered, and candidate species for federal listing (former Category 1 species) that are known to occur or that may

potentially occur in the Vandenberg AFB area. Species that are known or expected to occur on South Vandenberg AFB are discussed in more detail below. Former federal candidate Category 2 species, state species of special concern, and regionally rare and declining species on South Vandenberg AFB are discussed under the Vegetation and Wildlife subsections.

Several other listed plant species, the Gambel's watercress, the seaside's bird's beak, the Lompoc yerba santa, and the La Graciosa thistle, are not known to occur on South Vandenberg AFB, although they may occur on North Vandenberg AFB or in the overall vicinity (Oyler et al., 1995).

The unarmored threespine stickleback (fish) occurs on South Vandenberg AFB only as a transplanted population in C a ñ a d a Honda Creek (U.S. Air Force, 1991f) but also in San Antonio Creek on North Vandenberg AFB. The tidewater goby occurs on South Vandenberg AFB in the coastal lagoon and creek channel at Jalama Creek and has been observed in C a ñ a d a Honda Creek (U.S. Air Force, 1994c).

The southern steelhead trout, which was proposed for listing as federally endangered in August 1996, occurs in the Santa Ynez River and potentially in C a ñ a d a Honda Creek. However, none was identified during surveys conducted in 1994 and 1995. The California red-legged frog has been found in C a ñ a d a Honda and Jalama creeks on South Vandenberg AFB (U.S. Air Force, 1994c) and is reported to inhabit nearly all permanent lakes, streams, and ponds on Vandenberg AFB. In addition, red-legged frogs have been found in the retention ponds near SLC-6. Bear Creek does not support the deeper pool habitats essential for the survival of the red-legged frog (U.S. Air Force, 1991f). The California tiger salamander (federal candidate [former Category 1] and special concern species) is not known to occur on South Vandenberg AFB (Christopher, 1996a).

Table 3.14-2. Threatened, Endangered, and Candidate Species Occurring or Potentially Occurring at Vandenberg AFB, California

Common Name	Scientific Name	Federal Status	State Status
Plants			
Beach layia	*Layia carnosa*	E	E
Gambel's watercress	*Rorippa gambelli*	E	T
Seaside's bird's beak	*Cordylanthus rigidus* ssp. *littoralis*	-	E
Lompoc yerba santa	*Eriodictyon capitatum*	C	R
Beach spectaclepod	*Dithyrea maritima*	-	T
La Graciosa thistle	*Cirsium loncholepis*	C	T
Surf thistle	*Cirsium rhothophilum*	C	T
Fish			
Unarmored threespine stickleback	*Gasterostreus aculeatus williamsonii*	E	E
Tidewater goby	*Eucyclogobius newberryi*	E	-
Steelhead trout	*Oncorhynchus mykiss irideus*	E	-
Reptiles and Amphibians			
California red-legged frog	*Rana aurora draytonii*	T	SC
Green sea turtle	*Chelonia mydas*	T	-
Loggerhead sea turtle	*Caretta caretta*	T	-
Pacific Ridley sea turtle	*Lepidochelys olivacea*	T	-
Leatherback sea turtle	*Dermochelys coriacea*	E	-
Birds			
California brown pelican	*Pelacanus occidentalis californicus*	E	E
Bald eagle	*Haliaeetus leucocephalus*	T	E
American peregrine falcon	*Falco peregrinus anatum*	E	E
California black rail	*Laterallus jamaicensis coturniculus*	-	T
Western snowy plover	*Charadrius alexandrinus nivosus*	T	SC
California least tern	*Sterna antillarum browni*	E	E
Western yellow-billed cuckoo	*Coccyzus americanus occidentalis*	-	E
Southwestern willow flycatcher	*Empidonax traillii extimus*	E	E
Least Bell's vireo	*Vireo bellii pusillus*	E	E
Belding's savannah sparrow[(a)]	*Passerculus sandwichensis beldingi*	-	E
Mountain plover	*Charadrius montanus*	C	-
Mammals			
Guadalupe fur seal	*Arctocephalus townsendi*	T	T
Steller sea lion	*Eumetopias jubatus*	T	-
Southern sea otter	*Enhydra lutris nereis*	T	-
Sei whale	*Balaenoptera borealis*	E	-
Blue whale	*Balaenoptera musculus*	E	-
Finback whale	*Balaenoptera physalus*	E	-
Humpback whale	*Megaptera novaeangliae*	E	-
Right whale	*Balaena glacialis*	E	-
Sperm whale	*Physeter catodon*	E	-

Note: (a) Taxonomic status of subspecies is pending.
C = candidate (former Category C1)
E = endangered
R = rare (state designation)
SC = special concern (state designation)
T = threatened

Several federally listed bird species occur on South Vandenberg AFB. The southern bald eagle formerly nested in the Channel Islands and coastal Santa Barbara County but is now only a fall and winter visitor to these areas (U.S. Air Force, 1991f). The American peregrine falcon nests on rocky coastal cliffs on South Vandenberg AFB and the nearby Channel Islands and forages over the adjacent terraces and flats. Migrating and wintering individuals are also found at Vandenberg AFB.

California brown pelicans nest on the Channel Islands. They are found year-round in the coastal waters of Vandenberg AFB and roost at Point Pedernales, Destroyer Rock, Point Arguello, Rocky Point, and the Boathouse Breakwater (U.S. Air Force, 1994c). Brown pelicans generally forage close to shore, although they may venture farther out to sea during calm weather. While brown pelicans may use different sites to rest during the day, they return to land at night to roost in large numbers at particular sites. During the last quarter century, brown pelican nesting in California has been restricted to the offshore Channel Islands (National Aeronautics and Space Administration, 1993). California least terns nest from mid-April to August in sand dunes on North Vandenberg AFB but use the offshore water areas of South Vandenberg AFB for foraging and during migration (U.S. Air Force, 1991f).

The western snowy plover nests from March to September on approximately 12 miles of Vandenberg AFB beaches, from approximately 3.5 miles south of the Santa Ynez River mouth to approximately 1 mile north and on several miles of beaches and dunes from Purisima Point northward. This species nests in the vicinity of tidal waters in open to barren areas but does not nest colonially (Persons and Applegate, 1996). Western snowy plovers occur on the mainland coast, peninsulas, off-shore islands, and adjacent bays and estuaries. While adult western snowy plovers experienced a decline from the late 1970s to the late 1980s, the Vandenberg AFB population has remained relatively unchanged. The snowy plover winters at these locations and at Jalama Beach. Between March 1 and September 30 of each year, Vandenberg AFB limits recreational access to plover and least tern breeding beaches. This restriction is enforced by Vandenberg AFB game warden patrols.

The Least Bell's vireo, which nest on the upper Santa Ynez River, do not breed on Vandenberg AFB but may visit riparian woodlands at Cañada Honda, Spring, and Bear creeks (U.S. Air Force, 1991f). Southwestern willow flycatchers also breed along the Santa Ynez River but do not nest on South Vandenberg AFB, although Bear Creek apparently provides suitable habitat for this species (Holmgren and Collins, 1995). The western yellow-billed cuckoo is a bird of riparian habitats; occasional transients may forage in the Bear Creek willow woodlands (U.S. Air Force, 1991f). The California black rail and the Belding's savannah sparrow may occur at the Santa Ynez River estuary but are not known to occur any farther south on Vandenberg AFB (Holmgren and Collins, 1995; U.S. Air Force, 1991f). The mountain plover winters annually at the airfield on Vandenberg AFB.

The southern sea otter breeds year-round at Purisima Point off North Vandenberg AFB. No permanent population exists on South Vandenberg AFB, but sea otter are occasionally found feeding in kelp beds offshore (U.S. Air Force, 1994c). The southern sea otter is a federally threatened and state-listed rare species. These marine mammals tend to occupy relatively small ranges; the males of the species range slightly farther. Southern sea otters inhabit intertidal and shallow subtidal zones and are commonly associated with areas sustaining kelp beds. Breeding and pupping occur year-round. Factors attributed to the decline of and continued reduced numbers of southern sea otter populations include overharvesting until the first half of this century, gill and trammel netting mortalities, and limited food availability (National Aeronautics and Space Administration, 1993). The Guadalupe fur seal and the Stellar sea lion are very rare visitors to the Vandenberg AFB area. The Guadalupe fur seal was formerly abundant on the Channel Islands but is now only a rare summer visitor to San Miguel Island. Stellar sea lions used to breed on San Miguel Island, but none have been seen there since 1985.

Six species of endangered whales (the sei, blue, finback, humpback, right, and sperm) may occur in the offshore waters (U.S. Air Force, 1991f). In addition, four species of sea turtles (the green sea turtle, the loggerhead sea turtle, the Pacific Ridley sea turtle, and the leatherback sea turtle) may also occur in the offshore waters (U.S. Air Force, 1991f).

Several sensitive plant species may occur in coastal dune scrub near SLC-2W. Surf thistle and coast spectacle pod occur near SLC-2W. These plant species are both listed by the state of California as threatened. Coast spectacle pod is a federal candidate (former Category 1) species, while surf thistle is a former Category 2 species. Both of these species occur on active dunes. Because of this, localized demes (subsets of the overall population) are variable in numbers and distribution (National Aeronautics and Space Administration, 1993). Beach spectaclepod (also state threatened) is found in dunes near the community of Surf. Surf thistle (also state-threatened) is found in dunes and sandy bluffs along the coast between Surf and Point Arguello.

Two federally listed endangered species (the California least tern and the brown pelican) and two federally listed threatened species (the western snowy plover and the southern sea otter) occur in the vicinity of SLC-2W.

Concept A ROI. A population of endangered beach layia was located along Coast Road, approximately 1.3 miles west of SLC-3 (Oyler et al., 1995), which is adjacent to Bear Creek and near C a ñ a d a Honda Creek and the Santa Ynez River. These habitats support numerous sensitive species. No known sensitive species are known to be present at SLC-3W; however, suitable habitat is present at Bear Creek and Coast roads for sensitive plants that occur in the dune scrub habitats.

Concept B ROI. SLC-6 is near C a ñ a d a Honda Creek and cliffs, both of which support sensitive species. Peregrine falcons have been observed foraging over SLC-6 and occasionally roosting on structures at the complex on SLC-6 (Read, 1997). Red-legged frogs are known to occur in the retention ponds near the complex.

3.14.2.4 Sensitive Habitats. This analysis uses the Santa Barbara County Local Coastal Plan definition of environmentally sensitive habitat:

> "any area in which plant or animal life or their habitats are either rare or especially vulnerable because of their special nature or role in an ecosystem and which could be easily disturbed or degraded by human activities and developments."

Designated environmentally sensitive habitat in the ROI with the potential to be affected by the EELV program include butterfly trees, marine mammal hauling grounds, seabird nesting and roosting areas, white-tailed kite habitat, Burton Mesa chaparral, and wetlands including streams/riparian woodlands (U.S. Air Force, 1991f).

Butterfly Trees. The Monarch butterfly is a regionally rare and declining insect known to overwinter in the eucalyptus and cypress groves along Bear Creek near SLC-3 (U.S. Air Force, 1991f). Another major monarch overwintering area is located in Spring Canyon near SLC-3 (Read, 1997). The “butterfly trees” are protected as a monarch wintering habitat that is declining in California.

Marine Mammal Hauling Grounds. There are 3 miles of coastline between Oil Well Canyon and Point Pedernales designated as a marine ecological reserve. This includes a beach area south of Rocky Point used by harbor seals as haul-out and pupping areas. Vandenberg AFB and the California Department of Fish and Game have an MOA to limit access to this area to scientific research and military operations (U.S. Air Force, 1994c).

Seabird Nesting and Roosting Areas. Seabird nesting and roosting areas located on the Channel Islands and on South Vandenberg AFB are discussed under Wildlife, Section 3.14.2.2.

White-tailed Kite Habitat. White-tailed kite foraging habitat includes grassland and open coastal sage scrub. Kites are expected to forage in these habitats on South Vandenberg AFB primarily during the fall and winter. Potential roosting and nesting habitat occur in the willow, blue eucalyptus, and cypress trees along Bear Creek (U.S. Air Force, 1991f) and in the riparian habitat along the Santa Ynez River (Read, 1997).

Wetlands. Wetlands mapped by the USFWS on South Vandenberg AFB include areas along Bear, Spring, and C a ñ a d a Honda creeks; along the coast; and Lompoc, Grey, and Red Roof canyons (U.S. Department of the Interior, U.S. Fish and Wildlife Service, 1995).

C a ñ a d a Honda Creek Habitat. C a ñ a d a Honda Creek is the largest stream on South Vandenberg AFB (U.S. Air Force, 1988b). A perennially flowing stream, C a ñ a d a Honda Creek provides significant habitat for many wildlife species and for listed fish species. The stream supports a dense cover of vegetation, including riparian plant species such as arroyo willow, coyote brush, creek nettle, and bullrushes. Tule, cattails, and green algae densities

increase as the stream nears the interface with the Pacific Ocean (U.S. Air Force, 1985; 1988b).

C a ñ a d a Honda Creek has the most diverse assemblage of invertebrate species (approximately 25 species) on Vandenberg AFB. The more common of these invertebrates include stonefly, caddisfly, various snails, and amphipod crustaceans. This diversity of invertebrates is likely present because of the perennial nature of the stream and the density of riparian vegetation found within and on the banks of C a ñ a d a Honda Creek (U.S. Air Force, 1988b).

An introduced population of the federally listed endangered fish, unarmored threespine stickleback, persists in the perennially flowing portions of the stream (U.S. Air Force, 1988b).

Amphibians and reptiles occurring at C a ñ a d a Honda Creek include the western toad, the Pacific treefrog, the Pacific chorus frog, the red-legged frog, the western pond turtle, the common kingsnake, the common garter snake and the two-striped garter snake. Red-legged frog, western pond turtle, and western garter snake populations have declined because of habitat loss/alteration, harvesting for food, and/or introduced predators. The red-legged frog is federally listed as threatened under the Endangered Species Act; western pond turtles and two-striped garter snakes were formerly listed as federal Category 2 candidates. During summer, when the water flow decreases and portions of this stream become intermittent, amphibian and reptile populations may be reduced or localized to perennially inundated sections of the stream (Christopher, 1996a,b).

C a ñ a d a Honda Creek is an important environment for bird species as well. Avian species that may occur at this creek include woodpeckers, western wood peewees, common yellowthroats, and song sparrows. Winter migrants that may utilize this riparian corridor include ruby-crowned kinglets, hermit thrushes, and yellow-rumped warblers. Because of alteration or loss of riparian areas, bird species that depend on these habitats have declined in population. Yellow-billed cuckoos, long-eared owls, and willow flycatchers are among these dwindling bird species. Another reason for declines in these populations is brood parasitism by brown-headed cowbirds (U.S. Air Force, 1988b).

C a ñ a d a Honda Creek also provides a suitable environment for many mammalian species. Smaller mammals that may be found at C a ñ a d a Honda Creek include deer mice, dusky-footed woodrats, and Trowbridge shrews. Larger mammals commonly occurring in riparian woodlands include Virginia opossums, raccoons, striped skunks, and mule deer (U.S. Air Force, 1988b).

Santa Ynez River. The Santa Ynez River watershed drains approximately 900 square miles of land; approximately 45 square miles occurs on Vandenberg AFB (U.S. Air Force, 1988a). This river supports many sensitive species and becomes intermittent during the summer as water levels drop. This, along with high nutrient levels, supports dense, semi-aquatic plant growth. Invertebrate fauna are relatively less abundant and diverse than at C a ñ a d a Honda Creek, where water flows year-round, although invertebrates

such as oligocheate worms can thrive in the Santa Ynez River (U.S. Air Force, 1988b).

In contrast, vertebrate fauna are more diverse and abundant in the Santa Ynez River than in any other stream on Vandenberg AFB. Fish that are known to occur in the Santa Ynez River include mosquito fish, threespine sticklebacks, bass, bluegill sunfish, fathead minnows, arroyo chubs, and tidewater goby. The mouth of the Santa Ynez River forms a lagoon that periodically varies in temperature and salinity depending on the time of year and tidal fluctuations. Because this lagoon is often brackish, marine fish may be found including Pacific herring, starry flounder, and tidewater goby. A small extant native population of anadromus steelhead trout utilizes the Santa Ynez River watershed during spawning and early development (U.S. Air Force, 1988b).

The diversity of amphibian and reptile species on the Santa Ynez River is greater than that found on C a ñ a d a Honda Creek. In addition to those amphibian and reptile species found on C a ñ a d a Honda Creek (such as the western toad, the western pond turtle, the red-legged frog, the Pacific chorus frog, and the common garter snake), the Santa Ynez River supports bullfrogs, western terrestrial garter snakes, and common kingsnakes (Christopher, 1996). Gopher snakes occur in neighboring areas and may utilize this riparian area, preying on birds, small mammals, and other amphibian and reptile species.

Birds may occur among similar riparian environments such as the C a ñ a d a Honda Creek and the Santa Ynez River. Hairy and downy woodpeckers, as well as southwestern willow flycatchers, black phoebes, western wood peewees, warbling vireos, and black-headed grosbeaks, may be found in the Santa Ynez riparian corridor (U.S. Air Force, 1988c).

Mammal species associated with the Santa Ynez River tend to be similar to those at C a ñ a d a Honda Creek. In addition to those mentioned as present at C a ñ a d a Honda Creek, brush rabbits, bobcats, and feral pigs may be present (U.S. Air Force, 1988b).

Burton Mesa Chaparral. Burton Mesa chaparral occurs near SLC-3 and is considered a regionally rare and declining plant community with a highly localized occurrence (U.S. Air Force, 1991f). Several of the shrubs found in Burton Mesa chaparral on Vandenberg AFB are local endemics, including the shagbark manzanita and the coast and Santa Barbara ceanothus (U.S. Air Force, 1991f). The Bell's sage sparrow, a species of federal concern, is associated with Burton Mesa chapparal on North and South Vandenberg AFB.

Other Sensitive Plant Communities. Several plant communities that occur on Vandenberg AFB are considered sensitive because they contain sensitive plant species and/or are of limited extent. These include riparian woodland and associated freshwater herbaceous vegetation (U.S. Air Force, 1991f). These communities occur near SLC-3 and are described under Vegetation, Section 3.14.2.1.

Concept A ROI

Wetlands. An arroyo willow wetland has been identified in a drainage downstream of a concrete holding pond on SLC-3W (see Figure 4.13-5). Bear Creek Canyon wetlands are located adjacent to SLC-3. A small drainage ditch at the foot of the SLC-3W retention basin supports a willow scrub wetland.

Concept B ROI

Wetlands. Wetlands mapped by the USFWS include the evaporation and percolation ponds at SLC-6 (U.S. Department of the Interior, U.S. Fish and Wildlife Service, 1995). Three sites at SLC-6 exhibit wetland characteristics: a man-made ditch east of the former storage pad facility, a man-made trench south of the retention ponds, and a drainage south of the launch pad (see Figure 3.14-6). The first two locations have man-induced hydrology and are of low habitat value due to low vegetative cover and location, although the red-legged frog has recently been found at these locations (U.S. Air Force, 1994c). A field survey of the third wetland identified small patches of arroyo willow in a drainage that qualifies as a willow riparian wetland (ENSR Corporation, 1997b).

3.15 CULTURAL RESOURCES

Cultural resources include prehistoric and historic sites, structures, districts, artifacts, or any other physical evidence of human activity considered important to a culture, subculture, or community for scientific, traditional, religious, or any other reasons. For ease of discussion, cultural resources have been divided into archaeological resources (prehistoric and historic), historic buildings and structures, and native populations/traditional resources (e.g., Native American sacred or ceremonial sites). For Vandenberg AFB, the cultural resources section also discusses a fourth category, paleontological resources. There is no scientific or physical evidence for this category of resources at Cape Canaveral AS.

Regulatory Framework. Numerous laws and regulations require that possible effects to cultural resources be considered during the planning and execution of federal undertakings. These laws and regulations stipulate a process of compliance, define the responsibilities of the federal agency proposing the action, and prescribe the relationship among other involved agencies (e.g., the State Historic Preservation Officer [SHPO] and the Advisory Council on Historic Preservation). In addition to the NEPA, the primary laws that pertain to the treatment of cultural resources during environmental analysis are the National Historic Preservation Act (NHPA) (especially Sections 106 and 110) the Archaeological Resources Protection Act (ARPA), the American Indian Religious Freedom Act (AIRFA), and the Native American Graves Protection and Repatriation Act (NAGPRA).

Only those cultural resources determined to be potentially significant under the above-cited legislation are subject to protection from adverse impacts resulting from an undertaking. To be considered significant, a cultural resource must meet one or more of the criteria established by the National Park Service that would make that resource eligible for inclusion in the

National Register of Historic Places (National Register). The term "eligible for inclusion in the National Register" includes all properties that meet the National Register listing criteria, which are specified in the Department of the Interior regulations Title 36 CFR 60.4 and National Register Bulletin 15. Therefore, sites not yet evaluated may be considered potentially eligible for inclusion in the National Register and, as such, are afforded the same regulatory consideration as nominated properties. Whether prehistoric, historic, or traditional, significant cultural resources are referred to as "historic properties."

Region of Influence. For the purposes of this analysis, the term ROI is synonymous with the “area of potential effect” as defined under cultural resources legislation. In general, the ROI for cultural resources at each location, and for each concept, encompasses all areas requiring ground disturbance (e.g., areas of new facility/utility construction) and all buildings or structures requiring modification, renovation, demolition, or abandonment. The specific cultural resources ROIs for each concept at each location are described for Cape Canaveral AS in Sections 2.1.1.10 and 2.1.2.10 and for Vandenberg AFB in Sections 2.1.1.7 and 2.1.2.7. The Concept A/B ROI at each installation will encompass all of the facilities described in both the Concept A and Concept B ROIs.

3.15.1 Cape Canaveral AS

3.15.1.1 Prehistoric and Historic Archaeological Resources.

Archaeological investigations at Cape Canaveral AS indicate that human occupation of the area first occurred approximately 4,000 years ago. Early settlement was focused within the Banana River salt marsh environment; however, over time, site distribution and size fluctuated, and there is archaeological evidence that the entire peninsula was exploited for a wide variety of marine, estuarine, and terrestrial resources. Occupation of the area is divided into seven cultural periods: the Archaic Period, the Orange Period, the Transitional Period, the Malabar I, IIA, and IIB Periods, and the Protohistoric or Seminole Period.

European exploration and contact with native populations of the Florida coast began in the 15th century; however, Ponce de Leon's discovery of St. Augustine in 1513 is the first known documentation of these activities. Numerous Spanish treasure ships navigated the area throughout the 1500s, and in 1564, a French colony was established near the mouth of the St. John’s River. Hostilities developed between the French and Spanish, and although the native populations remained somewhat independent of these activities, displacement from their native lands, European diseases, and slavery ultimately resulted in their dispersal and demise. By the 1760s, the Cape Canaveral area was inhabited by only a few Spaniards and, according to historical accounts, the area remained sparsely populated until 1843 when a lighthouse was established. Historic homesteading followed, and by 1880, several citrus farms existed along the Banana River. Maritime activities increased during the early 1900s, and additional homesteads and roads were established between the Banana River and the Atlantic coastline. Fishing, gardening, berry gathering, beekeeping, and fruit farming all flourished until the late 1940s when the U.S. government began purchasing land on the

peninsula for the establishment of a long-range proving ground and missile test center.

Numerous archaeological surveys have been conducted at Cape Canaveral AS (Bense and Philips, 1990; Cantley et al., 1994; Le Baron, 1884; Levy et al., 1984; Long, 1967; Moore, 1922; Rouse, 1951; Stirling, 1935; U.S. Army Corps of Engineers, 1988, 1989, 1990b, 1991; and Wiley, 1954). In 1992, the USACE synthesized data from several of these studies and developed a cultural resources sensitivity map for Cape Canaveral AS (New South Associates, 1996). Fifty-six prehistoric and historic archaeological sites have been recorded; 19 of these sites have been identified as potentially eligible for listing in the National Register.

3.15.1.2 Historic Buildings and Structures. In 1949, the Cape Canaveral Long-Range Proving Ground was formally established under the direction of the Air Force. Construction of the first missile launch pads, support facilities, and down-range tracking stations began in 1950, and throughout that decade military facilities and activities developed at a rapid pace. Various cruise-type missiles were tested during these years and the installation began to support the Intermediate Range and intercontinental ballistic missile (ICBM) programs. Activity at the installation peaked in 1966 with more than 30 operational launch complexes; however, over the next 10 years, programs and operations began to decline. Launch complexes and support buildings that had served their purposes were adapted to other uses (e.g., facilities supporting manned and unmanned space exploration, including NASA's Viking missions to Mars and Voyager missions to the outer planets), deactivated or put on standby status. Current launch programs include ballistic missile operations and government and commercial launch operations (New South Associates, 1996).

Historic building and structure surveys at Cape Canaveral AS include those conducted by the National Park Service (1980); Resource Analysts, Inc. of Bloomington, Indiana (Barton et al., 1983); and the USACE Construction Engineering Research Laboratories (CERL) (McCarthy et al., 1994; Turner et al., 1994). Of these surveys, 14 National Register-listed or eligible historic buildings and structures have been identified (New South Associates, 1996). Seven of the 14 properties (6 launch complexes [5/6, 13 MST, 14, 19, 26, 34] and the original Mission Control Building) comprise a National Historic Landmark district associated with the Man in Space program. The remaining seven properties are Launch Complexes 1/2, 3/4, 17, 21/22, 25, 31/32, and the Cape Canaveral Lighthouse, all of which are considered eligible for inclusion in the National Register.

3.15.1.3 Native Populations/Traditional Resources. At the time of European contact, the Cape Canaveral and Banana River areas were populated by tribal groups of the Ais Indian tribe. Settlements were described by early explorers as sparse and isolated, and historical accounts indicate that they remained so well into the 18th century (New South Associates, 1993). The Ais settlements closest to Cape Canaveral AS were the Ulumay villages along the Banana River. The settlements were numerous, changed with the seasons, and reflected a fishing and gathering subsistence; agriculture was not practiced. Dwellings were temporary, and tools and utensils were typically fashioned of conch shell or gourds.

After European contact, the Ais had easy access to trade items and precious metals from the Spanish and French. Because of their proximity to the Straits of Florida, they also took advantage of the numerous shipwrecks along the Florida coast. Wrecks were looted for their treasure, and survivors were typically taken in as slaves and later bartered back to the Europeans. As described above, by 1760, few Ais remained, their disappearance attributable to European diseases, encroachment of their land, and enslavement. A few are believed to have moved into southern Florida where they may have banded with other tribes to ultimately form the Seminole culture. Today, there are no known direct descendants of the Ais tribe remaining; the Seminole and Micosukee Tribes are recognized as the appropriate Native American cultures for consultation during the treatment of Ais remains.

Significant traditional sites are subject to the same regulations and are afforded the same protection as other types of historic properties. Traditional resources associated with the Ais could include archaeological sites, burial sites, mounds, ceremonial areas, caves, hillocks, water sources, plant habitat or gathering areas, or any other natural area important to this culture for religious or heritage reasons. By their nature, traditional resources sites often overlap with (or are components of) archaeological sites. As such, the National Register-listed or -eligible sites (as well as any archaeologically sensitive areas) could also be considered traditional sites or could contain traditional resources elements.

Historic Property Status within the Concept A ROI. Within the proposed direct ground-disturbing areas for Concept A, no National Register-listed or -eligible prehistoric or historic archaeological sites have been identified. However, within the ROI for this concept, archaeologically sensitive areas as well as one National Register-eligible prehistoric site (8BR914, located near SLC-41) have been recorded (Appendix I). Of the identified National Register-listed or -eligible buildings and structures, none is currently within the cultural resources ROI for Concept A. A recent assessment of the historical significance of SLC-41 and Hangar J indicates that neither facility is likely to be eligible for listing in the National Register; concurrence from the Florida SHPO is pending.

Historic Property Status within the Concept B ROI. Within the proposed direct ground-disturbing areas for Concept B, no National Register-listed or -eligible prehistoric or historic archaeological sites have been identified. However, within the ROI for this concept, archaeologically sensitive areas encompassing three National Register-eligible prehistoric and/or historic archaeological sites have been recorded. The sites are 8BR82A, 8BR83, and 8BR221, located near SLC-37 (see Appendix I).

Of the identified National Register-listed or eligible buildings and structures, none is currently within the cultural resources ROI for Concept B. A recent assessment of the historical significance of Building 75251 and Hangar C (Building 1348) indicates that Building 75251 is not likely to be eligible for inclusion in the National Register. However, Hangar C has been found to be associated with events and persons significant in American History and the history of Cape Canaveral AS. Concurrence from the Florida SHPO is pending regarding the assessments of these two facilities.

3.15.2 Vandenberg AFB

3.15.2.1 Prehistoric and Historic Archaeological Resources. Archaeological investigations of Vandenberg AFB indicate that human occupation of the area first occurred approximately 9,000 years ago. Early settlement was characterized by a hunting and gathering existence; however, over time, coastal villages began to develop that were occupied a large part of the year. Development of the plank canoe around Anno Domini (A.D.) 500 increased travel by some of the Chumash groups to the Channel Islands and encouraged ocean fishing; however, full development of the indigenous culture did not occur until approximately A.D 1150 when a number of permanent and semi-permanent villages with populations of 200 to 600 were established (Environmental Solutions, 1990). The three major cultural periods recognized in the prehistory of the Vandenberg AFB area are the Early Period (7000-1500 B.C.), the Middle Period (1500 B.C.-A.D. 1000), and the Late Period (1000-1850 A.D.). From the Late Period until the present, the area has supported populations of Native American peoples speaking dialects of the Chumash language.

European exploration of the area began in the middle 1500s; however, colonization (by the Spanish) did not take place until around 1788 with the establishment of Mission La Purisima Concepcion and Mission Santa Ynez. By the middle 1800s, most of the mission lands had been transferred into secular ranchos with a large portion of the area of South Vandenberg AFB included in the Lompoc Rancho Mexican land grant; several farms and ranches operated on the Lompoc Terrace between 1880 and the 1930s (Versar, Inc., 1991). In 1941, the U.S. Army acquired most of the land area now known as Vandenberg AFB to construct Camp Cooke; the installation was renamed Vandenberg AFB in 1958.

Numerous archaeological surveys have been conducted at Vandenberg AFB, and over 2,000 prehistoric and historic archaeological sites have been recorded within the boundary of the installation. Recorded sites span the entire time period described above and are highly variable in function and content. Prehistoric site types include dense shell middens, scatters of stone tools and debris, concentrations of ground stone milling tools, village sites, stone quarries, and temporary encampments (Environmental Solutions, Inc., 1990). Historic site types are varied and reflect activities associated with mission establishment, ranching, and military activities.

3.15.2.2 Historic Buildings and Structures. In 1941, the U.S. Army acquired 92,000 acres along the California coast between Point Sal and Point Arguello as a new military reservation (Camp Cooke). During the first five years, a variety of military activities took place at the installation, including use of a portion of the facility as a World War II prisoner of war camp between 1944 and 1946. In mid-1946, the installation was placed in caretaker status and most of the land leased for agriculture; however, by 1950, the base had been reactivated to support armored infantry training for the Korean War (Versar, Inc., 1991). In 1957, the northern 65,000 acres of Camp Cooke were transferred to the U.S. Air Force and became known as Cooke AFB; it was renamed Vandenberg AFB in 1958 when the Strategic Air Command became the host command for the installation. The southern portion of the

installation (approximately 20,000 acres) was controlled by the Navy as the Naval Missile Test Facility at Point Arguello until 1964, when it was also transferred to the Air Force. The present extent of the installation was completed in 1966, when an additional 15,000 acres was purchased from the Sudden Ranch.

Selected as the location for the construction of facilities to launch several types of intermediate and long-range ballistic missiles (e.g., Atlas, Thor, Titan), Vandenberg AFB missions have been largely associated with the launch of military and civilian payloads since the mid-1950s. In addition, Terrier and Hawk missile training exercises and launches of Nike/Asp sounding rockets took place between 1958 and 1960. SLC-3 (East and West), which is eligible for listing in the National Register, was originally constructed for the Air Force's space program under the supervision of the Navy and was designed to accommodate the Atlas D missile (Tri-Services Cultural Resources Research Center, 1996). Construction of SLC-6, which has been determined ineligible for listing in the National Register, began in the late 1950s as part of the Manned Orbiting Laboratory Project. The Space Transportation System launch facilities (including SLC-6) were constructed in the early 1980s; however, the project was suspended, and later canceled in 1986. The 30 SW is currently the host command at Vandenberg AFB and manages the WR, which conducts west coast military and civilian space and missile launch operations.

3.15.2.3 Native Populations/Traditional Resources. At the time of European contact, the Vandenberg AFB area was populated by peoples speaking one of the major languages (Purisimeno) of the Chumashan branch of the Hokan language family (Gibson, 1991). Explorers found the Chumash society quite complex with a variety of settlement patterns, customs, and beliefs and a currency-based economy. Villages were numerous and typically consisted of domed houses, granaries, ceremonial areas, game fields, and a burial ground. Tools were made of bone, shell, or steatite, and primary subsistence was from marine resources, the gathering of acorns, and small game. One of the most significant of the Chumash settlements in the vicinity of South Vandenberg AFB is the village of Nocto (currently identified as archaeological site #SBA-210), approximately two miles south of SLC-6; Nocto consisted of ten houses and is believed to have supported between 60 and 70 residents (Glassow, 1990). Additional Purisimeno villages were also located in the area now encompassed by North Vandenberg AFB.

For nearly 200 years after the first explorers made contact, the Chumash life and culture continued without European interference. However, in the mid-18th century, the Spanish began to colonize the area and establish missions. When it became apparent that the Chumash were not willing to give up their traditions and embrace Christianity, the priests and the Spanish military captured many of the Chumash and forced them to live and work at the missions. By 1833, thousands of Chumash had died from European-introduced diseases, many of their villages were abandoned, and many others had fled the area. Changes in governmental administration of the area (i.e., from mission rule to Mexican government rule, and, ultimately, to United States rule) did little to improve the living conditions of the Chumash peoples, and by 1850, the formerly vast and powerful Chumash nation was reduced to several small groups. In 1901, the U.S. government ceded 75

acres of reserved land next to the Santa Ynez mission to the Chumash. The Santa Ynez Reservation is the only land held by the Chumash today (Gibson, 1991); it is located approximately 20 miles east of Vandenberg AFB. Vandenberg AFB has maintained a cooperative and interactive relationship with the Chumash Indians for many years.

There are numerous traditional resources sites associated with the Chumash at Vandenberg AFB including prehistoric villages and campsites, rock art panels, burial sites, resource gathering areas, trails, and wetlands. In addition, there is a specifically identified traditional cultural property in the vicinity of Point Conception, referred to by some within the Chumash culture as the Western Gate because of its role in Chumash beliefs about death and the afterlife.

3.15.2.4 Paleontological Resources. Paleontological resources include examples of ancient organic life preserved as fossils. Fossils found in the vicinity of Vandenberg AFB include remains of both vertebrate and invertebrate animals. Remnants of Pleistocene Epoch (a period of time between 2 million and 8,000 years ago) terraces are found on South Vandenberg AFB, especially on the low marine terrace known as Sudden Flats, which extends west to the U.S. Coast Guard Lifeboat Rescue Station and Lookout Tower. Fossil remains found in this area include mammoth and horse fossils approximately 45,000 years old.

Historic Property Status within the Concept A ROI. Vandenberg AFB has completed archaeological surveys and inventories of the entire installation that satisfy the requirements of Section 110 of the NHPA. Approximately 2,200 prehistoric and historic sites have been identified and recorded, and a comprehensive survey report is in progress (Environmental Solutions, Inc., 1990; Glassow, 1990; Versar, Inc., 1991). Three archaeological sites have been identified in the vicinity of SLC-3; however, none of the three is located within the SLC-3W fenceline (Versar, Inc., 1991), and all three have been determined ineligible for inclusion in the National Register. In addition, no sites are located within the immediate areas where intersection widening would occur or where power poles require raising. However, the corner of Coast and Bear Creek roads is near known sites, one of which is National Register-eligible (Site #SBA 534). There are also no recorded sites in the direct construction areas associated with the modification of the entrance/exit driveway to Building 7525 or the construction area for the new USF (within the SLC-3W fallback area).

The entirety of Vandenberg AFB has been evaluated for historic buildings and structures potentially eligible for inclusion in the National Register. Specific features of SLC-3W (the MST and umbilical mast, the retention basin and deluge channel, and Building 770) have been determined eligible under the Cold War historic context (Tri-Services Cultural Resources Research Center, 1996). Building 8510, also identified for use within Concept A, has been determined eligible for inclusion in the National Register as a Cold War-era support facility associated with SLC-4.

There are no recorded fossils in the immediate vicinity of SLC-3W and no National Natural Landmarks within the Concept A ROI.

Historic Property Status within the Concept B ROI. Vandenberg AFB has completed archaeological surveys and inventories of the entire installation that satisfy the requirements of Section 110 of the NHPA. Approximately 2,200 prehistoric and historic sites have been identified and recorded, and a comprehensive survey report is in progress (Environmental Solutions, Inc., 1990; Glassow, 1990; Versar, Inc., 1991). Fifteen sites have been recorded near SLC-6; six have been recommended as eligible for inclusion in the National Register, and one (Site #SBA 2032) is near the location for the HIF. Underwater survey of the boathouse dock harbor did not identify any underwater archaeological resources (U. S. Department of the Interior, National Park Service, 1978).

All of the SLC-6 buildings and structures (inside and outside the fenceline) have been evaluated for eligibility for inclusion in the National Register and have been determined ineligible. Other facilities within the ROI for Concept B that have been determined eligible for inclusion in the National Register include the Point Arguello U. S. Coast Guard Lifeboat Rescue Station and Lookout Tower (adjacent to the South Vandenberg AFB Boat Dock) and Building 8510, which is a Cold War-era support facility associated with SLC-4.

The closest identified traditional resource site to the Concept B ROI is archaeological site #SBA 210, the site of the prehistoric village of Nocto (two miles south of SLC-6). However, site #SBA 2032, which is near the area proposed for the HIF (within the SLC-6 complex), may be associated with the village of Nocto, and may be a traditional resources site as well.

Fossils recorded near SLC-6, but not directly within the ROI, include fish, crab, and whale bone (U.S. Air Force, 1989a). There are no National Natural Landmarks within the Concept B ROI.

3.15.3 No-Action Alternative

Cape Canaveral AS ROI. The No-Action Alternative ROI at Cape Canaveral AS encompasses SLCs 17, 36, 40, and 41, all of which currently support the launch programs that would be replaced with implementation of the EELV program. Under the No-Action Alternative, these facilities would continue to be utilized to support those programs; however, none of these facilities would require modification. The National Register status of SLCs 17, 36, 40, and 41 is as follows: SLC-17 is eligible for listing on the National Register and is currently undergoing Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER) recordation. SLC-36 is also eligible for inclusion in the National Register (New South Associates, 1996), and HABS/HAER recordation is complete. SLC-40 remains unevaluated; however, it was completely renovated in 1993, and all of its original primary components have been demolished. The historical significance of SLC-41 has been recently assessed, and it is unlikely that it is eligible for listing in the National Register; Florida SHPO concurrence is pending.

Vandenberg AFB ROI. The No-Action Alternative ROI at Vandenberg AFB encompasses SLCs 2W, 3E, and 4E, all of which currently support the launch programs that would be replaced with implementation of the EELV program. Under the No-Action Alternative, these facilities would continue to be utilized to support those programs; however, none of the facilities would require modification. SLCs 2W, 3E, and 4E have been evaluated for their eligibility for inclusion in the National Register, and specific components of all four complexes have been determined eligible (see Appendix I).

3.16 ENVIRONMENTAL JUSTICE

EO 12898, Environmental Justice, was issued by the President on February 11, 1994. Objectives of the EO, as it pertains to this EIS, include development of federal agency implementation strategies, identification of minority and low-income populations where proposed federal actions have disproportionately high and adverse human health and environmental effects, and participation of minority and low-income populations. Accompanying EO 12898 was a Presidential Transmittal Memorandum that referenced existing federal statutes and regulations to be used in conjunction with EO 12898. The memorandum addressed the use of the policies and procedures of the NEPA. Specifically, the memorandum indicates that, "Each Federal agency shall analyze the environmental effects, including human health, economic and social effects, of Federal actions, including effects on minority communities and low-income communities, when such analysis is required by the NEPA 42 U.S.C. Section 4321, et seq." Although an environmental justice analysis is not mandated by NEPA or by AFI 32-7061, DoD has directed that NEPA will be used as the primary approach to implement the provision of the EO.

Although EO 12898 provides no guidelines as to how to determine concentrations of minority or low-income populations, the demographic analysis provides information on the approximate locations of minority and low-income populations in the area potentially affected by the EELV program at Cape Canaveral AS and Vandenberg AFB. Most environmental impacts resulting from the Proposed Action would be expected to occur within Brevard County, Florida, and Santa Barbara County, California.

The 1990 Census of Population and Housing reports numbers of both minority and poverty residents. Minority populations included in the census are identified as Black; American Indian, Eskimo, or Aleut; Asian or Pacific Islander; Hispanic; or Other. Poverty status (used in this EIS to define low-income status) is reported as the number of families with income below poverty level ($12,764 for a family of four in 1989, as reported in the 1990 Census of Population and Housing).

3.16.1 Cape Canaveral AS

Most environmental impacts resulting from the Proposed Action at Cape Canaveral AS would be expected to occur within Brevard County, Florida. Based upon the 1990 Census of Population and Housing, Brevard County had a population of 398,978 persons. Of this total, 49,681 persons, or 12.45 percent, were minority, and 35,815 persons, or 9.13 percent, were low-income.

3.16.2 Vandenberg AFB

Most environmental impacts resulting from the Proposed Action at Vandenberg AFB would be expected to occur within Santa Barbara County, California. Based upon the 1990 Census of Population and Housing, Santa Barbara County had a population of 369,608 persons. Of this total, 124,534 persons, or 33.69 percent, were minority, and 45,226 persons, or 12.76 percent, were low-income.